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This is the second Journal to be published by the Society; a Society so young, some might think, and quite reasonably, such a publication beyond its expectations until it 'grew up,' as it were. But with the confidence, the tremendous help of its executive Committee, its rapidly increasing membership and its most enthusiastic members, the first Journal of the Society appeared last year. This issue found its way into no less than 54 countries. Excellent reviews were received from other journals, and much praise from world malacologists. Opinions were generously given that the format, the paper, type, illustrations, and most importantly, the high standard of its articles, were first class. Thus the Journal of The Malacological Society of Australia, set a standard with its initial appearance, which its members intend to uphold in the future, as shown by our Journal No. 2.

Although any malacological journal may equally be chosen for a review by *Nature*, the following covered the Society's first number of its Journal, and says:

"The study of malacology in Australia may be considered to have commenced when *Endeavour*, commanded by Capt. Cook, anchored in Botany Bay, New South Wales, and Dr. Solander collected on its shores in 1770. Since that time a number of malacologists both from outside in the early days and, more recently, from within the continent, have studied its molluscs. While much still remains to be discovered, sufficient is known to indicate that it has one of the richest molluscan faunas in the world. Most of the States have enthusiastic clubs or groups, but it was not until the end of 1956 that the Malacological Society of Australia had its first meeting in Melbourne. In September of the following year the membership was more than 100, and No. 1 of the Journal of the Society appeared. . . . This consists of 52 pages almost identical in size with those of the *Proceedings of the Malacolocial Society*, six of them utilized as plates. It contains eleven articles, of which the longest two deal with epistho-branchs, and the author of the second, Robert Burn, has set an example which it is hoped will be followed by subsequent writers, of presenting type specimens to a national museum. One of the patrons of the Society is Prof. R. Tucker Abbott of the Academy of Natural Sciences, Philadelphia, a very fittting selection in view of the old association between the Academy and Australian malacologists. The paper, printing and general format of the journal are very good, and it is a praiseworthy start. We should like to wish the Society and its journal every success."

Nature, Vol. 181, No. 4623, pp. 1574-1575.

EDITOR.

NOTES ON THE ANATOMY OF THE AUSTRALIAN VOLUTES, *BEDNALLI* and *GROSSI*

By R. TUCKER ABBOTT, Ph.D.,*
Pilsbry Chair of Malacology,
Academy of Natural Sciences of Philadelphia.

(Plate 1, Text figures 1-2.)

I have recently had an opportunity, through the kindness of Colonel Alvin R. Cahn of Tokyo, Japan, and Miss Elizabeth M. Wistar of Chestnut Hill, Pennsylvania, of examining the soft parts of two rare volutes from Australia. This is not an attempt to define or revise the very confusing genera and subgenera of northern Australian volutes. We provisionally place *Cymbiola bednalli* and *C. grossi* in the subgenus *Volutoconus* Crosse, 1871. We use *Cymbiola* Swainson, 1831 (tautotype: *cymbiola* Sowerby, 1825, ex Chemnitz, vol. 10, figs. 1385-1386 = *cymbiola* Gmelin, 1791) in the same broad sense as does Wenz, 1943, pt. 6, p. 1334, who includes *Aulica* Gray, 1847, *Aulicina* Rovereto, 1899, *Callipara* Gray, 1855, and *Volutoconus* Crosse, 1871, as subgenera. We do not follow the very confused revision by Pilsbry and Olsson, 1954.

CYMBIOLA (*VOLUTOCONUS*) *BEDNALLI* Brazier

(Plate 1, fig. 3; text fig. 1)

1879 *Voluta bednalli* Brazier, *Proc. Linn. Soc.*, N.S.W., Vol 3, p. 81, pl. 8, fig. 3 (Port Darwin, Australia); 1894, Sowerby, *Proc. Malac. Soc., London*, Vol. 1, p. 49; 1880, Angas, *Proc. Zool. Soc., London*, for 1880, p. 418, pl. 40, fig. 1 (in colour); Allan, *Australian Shells*, Melbourne, plate opposite p. 224, fig. 1 (in colour).

Our five live-collected *C. bednalli* (ANSP No. 210685) were obtained by Dr. T. Ino off Darwin, North-West Australia, 6th August, 1957, in 23 to 25 fathoms. The bottom is a mud-sand mixture, and *bednalli* lives buried in the bottom with only the tip of the spire projecting above the surface. Live specimens are uncommon.

As indicated by our synonymy, *bednalli* has been adequately figured and described. When fresh, the colour markings on the shell are dark chestnut-brown, but in dead specimens this fades to a light chestnut. In one of our specimens, the body whorl bears 10 long, low, indistinct, axial plications at the periphery. The large, rounded nucleus in all five specimens consists of 3½ whorls, the summit bearing a very small, dark brown spur. This is followed by one smooth, glossy, brown whorl, following which the next 2½ whorls bear numerous low, tiny, axial riblets. There is a minutely raised spiral thread just below the well-impressed suture. The nuclear whorls are yellowish white in colour, with a narrow, irregular brown band just above the suture.

Animal.—The soft parts are typically volutid, rather closely resembling those of *Cymbiola* (*Aulicina*) *vespertillo* Linne in general structure, but without any distinctive colour pattern. The soft parts preserved in alcohol

* Philadelphia, Pennsylvania.

were pinkish in colour. The head is proportionately much smaller than that in *Voluta musica* Linne. Tentacles moderately long and thin. Siphonal appendages short, the left one being only slightly larger than the right. The interior of the rhynchostome is heavily beset with small cartilagenous papillae. Operculum absent.

The odontophore from a shell 103 mm. in length is about 5 mm. in length, narrow, strong, and with 43 rows of strong, uniserial teeth, whose bases are closely set together, so that the cusps overlap two teeth in front. The tooth has a moderate, thick base, a very large, narrow, arching central cusp. On each side is a lateral cusp, which is one-third as large, thinner and narrower. The central cusp is triangular in cross-section.

Remarks: Until the animal of the type species of *Volutoconus* is known (*V. coniformis* Cox 1871, *J. Conchyliol.*, 19, p. 74, pl. 4, fig. 1, Nichol Bay, Western Australia), there will be some doubt as to the wisdom of placing *bednalli* or *grossi* in that subgenus, although on conchological grounds it seems reasonable. The radulae and nuclear shell characters of *bednalli* and *grossi* are quite similar to each other.

CYMBIOLA (*VOLUTOCONUS*) *GROSSI* Iredale.
(Plate 1, Figs. 1, 2, 5; Text fig. 2.)

1927 *Amoria grossi* Iredale, *Aust. Zool.*, Vol. 4, p. 336, pl. 46, fig. 2 (Caloundra).

Description: Adult shell 98 to 116 mm. (3¾ to 4½ inches) in length, solid, elongate, glossy, and salmon-red in colour. Whorls 6 to 7, slightly shouldered, unevenly descending to give the spire a "lop-sided" appearance. Nuclear whorl about 1½, very small, rapidly descending, with slightly concave sides, alabaster white, and raised into a sharp, spine-like projection. Following two post-nuclear whorls bulbous, evenly rounded, regularly descending, weakly malleated, especially the uppermost one, with a dozen microscopic spiral threads, and coloured a bright organge-tan. There is a fine, white spiral line just below the minutely impressed suture. The last 2½ whorls increase their rate of descent, are slightly concave below the suture, and gently swollen at the periphery. Spiral sculpture absent; axial sculpture of numerous, uneven, fine lines of growth, and generally with one or two scars from formerly damaged lips. Ground colour of body whorls yellowish or bluish white, over which is a heavy diffusion of spreading reticulations and mottlings of light carmine red. There are three or four indistinct narrow bands of red showing on the outside of the last whorl. Interior of aperture whitish rose. Outer lip sharp, slightly thickened and slightly compressed at the middle. Columellar plaits well developed, strongly slanting, squarish in cross-section, glossy white with a taint of pink, and the uppermost being the largest. Above the latter there may be a small, swollen, white, button-like callus. Parietal wall sometimes weakly glazed with "melted brown sugar" material. Siphonal fasciole deep, U-shaped, its scar leading back to the second plait from the top. Operculum wanting.

Measurements (mm.)—

Length of Shell	Length of Spire	Width	
115.5	38.0	38.5	ANSP No. 225313
110.3	32.4	36.8	A. J. Ostheimer, 3rd.
111.5	30.0	34.6	John duPont Coll'n
98.2	27.5	33.7	ANSP No. 225313
(118	not given	48	Holotype, fide Iredale, 1927)

Type locality.—Caloundra, north end of Moreton Bay, 60 miles north of Brisbane, Queensland, Australia. Dead shell collected about 1903 by Mr. George Gross.

Additional records.—Miss Elizabeth M. Wistar of Chestnut Hill, Pennslyvania, presented two of the above specimens to the Academy of Natural Sciences of Philadelphia. They and several others were obtained by an Australian correspondent from shrimp trawlers operating in about 33 fathoms, a few miles south-east of Fraser Island, Wide Bay, Queensland. This is about 70 miles north of the type locality.

Animal.—Unfortunately, only one shell (98.2 mm. in length) contained a rotted, dried animal, from which only the odontophore was recovered. The latter consists of a strong, narrow, small ribbon 4.5 mm. in length, with about 35 rows of strong uniserial, tri-cuspid teeth. Their bases are placed close to each other, so that the long cusps overlap the next two teeth. The base is sturdy, thick, and gives rise at the centre to a strong, narrow, arching, central cusp. On each side there is a lateral cusp of about half the size of the middle one.

Remarks.—This rare species was originally described by Iredale as an *Amoria* Gray 1855. However, the Y-shaped, uniserial teeth of *Amoria* bear only a single central cusp, and the nucleus of the shell does not bear a small, spine-like projection. *C. grossi* is now placed in the subgenus *Volutoconus* with some reservation. This is done because of the resemblance of the radula, nucleus and columellar plicae to those of *bednalli*.

A fourth species, *hargreavesi* Angas, in all likelihood belongs to *Volutoconus*, although I have not seen specimens. It was described without locality data (*Proc. Zool. Soc.*, London, for (1872), p. 613, pl. 42, fig. 13), although it possibly comes from Queensland or New Caledonia. *C.* (*V.*) *hargreavesi* resembles *grossi* in colour and general shape, but is considerably broader and has three columellar folds, the upper two being large and almost at right angles to the axis, much as in *bednalli*. From Angas' figure, the apex appears to be obtuse like that in *bednalli*.

REFERENCES.

Pace, S., 1902. On the Anatomy and Relationships of *Voluta musica*, Linn.; with Notes upon certain other supposed members of the Volutidae. *Proc. Malac. Soc.*, London, Vol. 5, No. 1, pp. 21-31, figs, 1-11.

Cooke, A. H. 1922. The Radula of the Volutidae. *Proc. Malac. Soc.*, London, Vol. 15, pt. 1, pp. 6-12, figs. 1-8.

Pilsbry, H. A., and A. A. Olsson 1954. Systems of the Volutidae. *Bull. of Amer. Paleontol.*, Vol. 35, No. 152, pp. 1-27, 4 pls.

Wenz, W. 1943. *Handbuch der Palazoologie*, Berlin, Vol. 6, pt. 6, pp. 1201-1505.

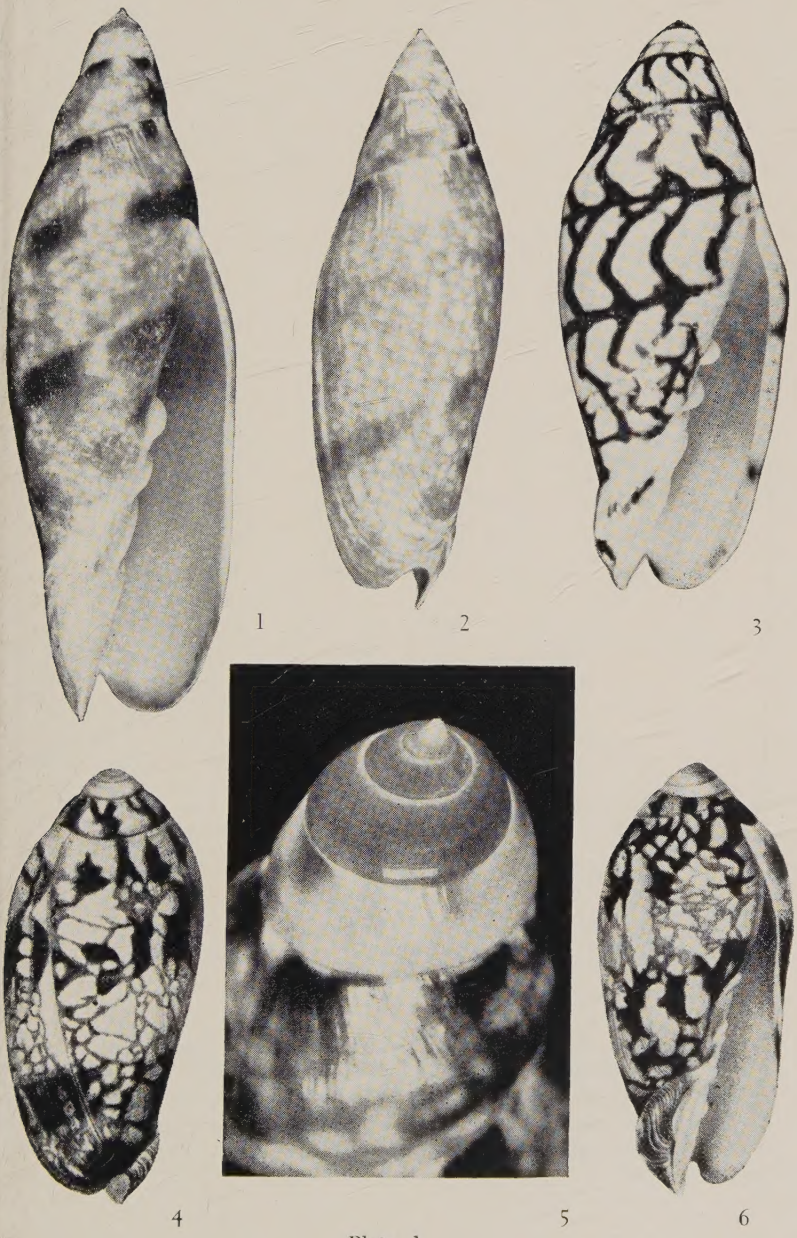
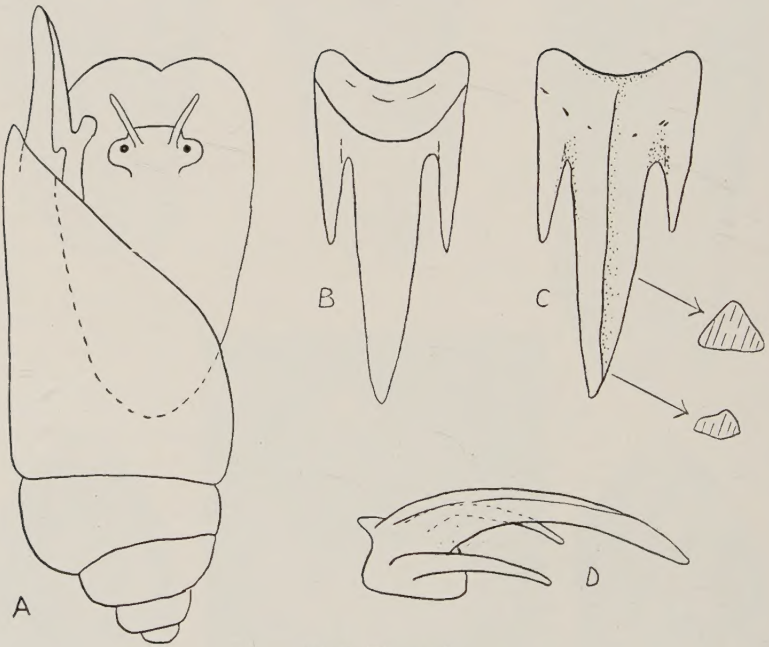


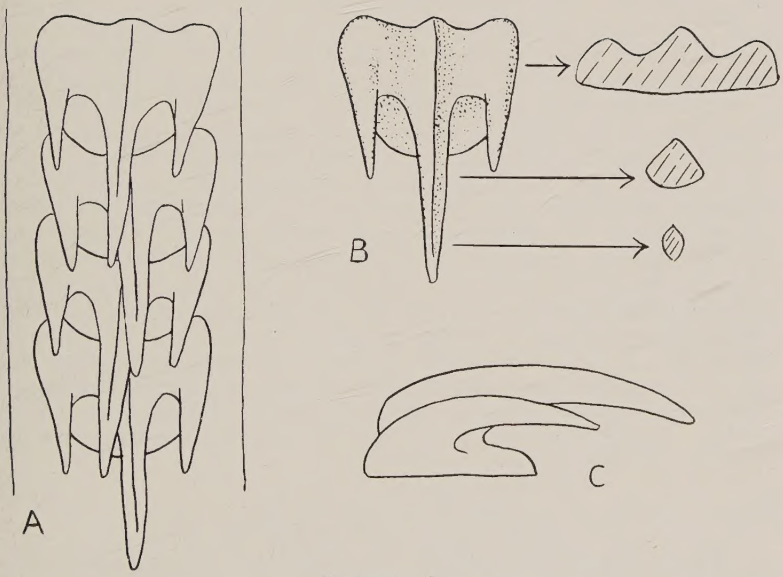
Plate 1.

Plate 1. Figs. 1 and 2, *Cymbiola* (*Volutoconus*) *grossi* Iredale (A.N.S.P. No. 225313); 3, *Cymbiola* (*Volutoconus*) *bednalli* Brazier (A,N,S.P. No. 210685); 4 and 6, *Cymbiola* (*Volutoconus*) *coniformis* Cox (from the *J. Conchyliol*, Vol. 19, pl. 4); 5, apical view of C. (V.) *grossi* Iredale (fig. 5 magnified X 10, others slightly reduced).



Text Figure 1.

Text fig. 1. *Cymbiola* (*Volutoconus*) *bednalli* Brazier. A, dorsal view of soft parts (preserved animal), showing siphon at the left with its two siphonal appendages, the head, foot and visceral mass; B, attachment side of rachidian tooth; C, dorsal view of rachidian tooth showing two cross-sections; D, three-quarter side view of rachidian tooth. (fig. A reduced ½, radula X 100).



Text Fig. 2.

Text fig. 2. *Cymbiola* (*Volutoconus*) *grossi* Iredale. A, dorsal view of odontophore showing alternating arrangement of teeth; B, dorsal view of rachidian showing three cross-sections; C, side view of rachidian tooth. (X 100).

WESTERN AUSTRALIAN COWRIES

By BERNARD C. COTTON, F.R.Z.S.*

(Plates 2-5.)

The last of Charles Hedley's State lists of Mollusca was that dealing with the fauna of Western Australia published in 1916. He realized that Conchologically, this area was comparatively little worked, and that it offered an interesting field for future investigators: so that his list, although so carefully compiled, can be regarded only as a good pioneer effort.

The inter-tropical North-Western fauna differs considerably from the extra-tropical South-Western fauna, though there is an overlap of, say, 20% of the species. This percentage cannot be definitely decided until a more comprehensive and accurate faunal list is available. The fauna of the Dampierian region, extending in Western Australia from Shark Bay to Wyndham, has probably received even less attention from students than that of the Flindersian region, extending from Shark Bay South and East to South Australia, though both areas need much more investigation.

Fortunately, explorations made by Dr. J. C. Verco during 1910-1911 have added to our knowledge of this area, and specimens he collected on the beaches and by dredging are in the South Australian Museum.

As an example of the increased knowledge we now have of Western Australian molluscs, we may take the Cowries. Hedley listed forty species of true Cowries and relatives belonging to the Superfamily Cypraeacea. As a consequence of intensive study, the nomenclature of the Cowries has become enlarged and stabilized, and now we are able to give a more accurate and comprehensive list. We find that Western Australia has about seventy different kinds of Cowries, and still a few more may remain to be discovered. It is not anticipated, however, that many new species will be found. In this paper, space and time permits only the illustration and some remarks on true Cowries, while the Eatoidae, Triviidae (Coffee Bean Shells), Amphiperatidae (Egg Cowries), all of which are represented in Western Australia, are simply listed.

FAMILY CYPRAEIDAE.

SUBFAMILY PUSTULARIIAE.

One species, *Pustularia globula*, with a callous on the spire and without granules, blotching or dorsal sulcus, is the Western Australian representative of this subfamily.

SUBFAMILY STAPHYLAEINAE.

Peculiar representatives of this sub-family is "Wrinkled Cowry" *Nuclearia nucleus* from N.W.A., a small flesh-coloured shell with a wrinkled and noduled surface, and *Staphylaea staphylaea*, with its numerous small granular and spots.

SUBFAMILY UMBILINAE.

Umbilicate shells, known as "Wonder Cowries," live on our Southern Coast. The original specimen found was considered to be a monstrosity of the "Tiger" or "Panther Cowry," but an example later received by the British Museum, from Bass Strait, proved the species to be an authentic one. In

* Adelaide Museum, Adelaide, South Aust.

S.W.A. a rare species, the "Apricot Cowry," *Umbilia hesitata armeniaca,* was dredged by the Federal trawler "Endeavour" in the Great Australian Bight in 100 fathoms. There is no specimen of the species in the South Australian Museum, and all shells labelled "C. *armeniaca*" examined by me in collections have proved to be the Tasmanian *U. hesitata.* It may be found by dredging in Western Australian waters. Of some 2,000 specimens of *U. hesitata* dredged in Bass Strait and examined by C. Kurtze, and many of them by myself, only a few verged to the *U. armeniaca* form.

The ecotype *U. hesitata howelli* Iredale 1931, (*U. hesitata alba* Cox 1880) has not yet been seen from the Flindersian region. Incidentally, there is a miniature white variant of this.

There are nine Tertiary species of this genus found in the Miocene and Pliocene.

SUBFAMILY ZOILINAE.

Another group of Cold-Water Cowries includes the well-known "Black Cowry," common in South Australia, living in a depression on a particular yellow sponge *Ecionemia robusta.* In S.W.A. is found the closely allied *Zoila thersites episema,* and in deeper water occurs *Z. contraria,* first dredged in 100 fathoms, ninety miles west of Eucla. A small relative is the "Dwarf Black Cowry," *Z. decipiens,* common in N.W.A. The most extraordinary one of the lot is *Z. rosselli* from Fremantle, a miniature "Black Cowry" with a keeled edge. On 10th March, while visiting the Nautical Museum, Port Adelaide, I was surprised to find two specimens of *Z. rosselli* on show, probably sent to that Institution by Mr. H. Rossell of Perth. They are now in the Hartley Collection, Melbourne. This accounts for six specimens. It is said, however, that there is a seventh in the Australian Museum, from Cottesloe, W.A. Rather distinct from this group are the more elongated "Cold-Water Cowries," *Z. friendi* and the extremely rare *Z. vercoi,* the original three specimens of the latter being in the South Australian Museum, but Mr. H. Rossell has now kindly added a fourth. There are four Tertiary fossil species of *Zoila.*

SUBFAMILY CYPRAEOVULINAE.

This sub-family includes a series of small Southern Australian shells, such as the "Peppered Cowry" *Notocypraea piperita,* "Verco's Cowry" *N. vercovis,* somewhat like a common South African species, the "Flesh-coloured Cowry" *N. subcarnea* and the intricately marked "Mottled Cowry" *N. declivis occidentalis* from S.W.A. and N.W.A. A sinistral specimen of *N. declivis,* from Tasmania, is in the S.A. Museum Collection. It was noticed by Lt.-Col. R. J. Griffiths. Two fossil species somewhat like *N. piperita* are found in the Pliocene of South Australia. A narrower shell is the "Eucla Cowry" *Guttacypraea euclia* taken in 100 fathoms west of Eucla. It is greyish-white with fine teeth. A shallow water relative is *Guttacypraea pulcaria,* more common in S.W.A. than S.A.

SUBFAMILY AUSTROCYPRAEINAE.

A series of nine fossil species of this ancient genus ranges from the Lower to Middle Miocene, while the remarkable *A. reevei* of S.W.A. and S.A. is the only living representative. The animal is beautifully coloured, having a dark amber mantle beset with numerous three to five-pointed

filaments of a peculiar frost-like colour, and on the sides of the mantle are numerous narrow, rectangular black marks appearing to the naked eye as short vertical lines; the foot is amber, its posterior end pink, as are also the siphon and tentacles. All species have shells with a sculpture of hammer-like marks on the dorsum.

SUBFAMILY TALPARIINAE.

Three Cowries of striking colour pattern are found in this subfamily—all occurring in N.W.A. There is the small "Orange-tipped Cowry," *Basilitrona isabella*, the large "Eye Cowry," *Arestorides argus*, pale brown, three banded and covered with numerous brown rings, and the Mole Cowry, *Talparia talpa*.

SUBFAMILY ERRONEINAE.

Five genera of smaller Cowries are represented here. *Erronea* and *Palangerosa*, in which the shell margins are not spotted; *Ovatipsa* and *Blasicrura*, with spotted margins. *Ovatipsa* has coarse teeth and *Blasicrura* has fine teeth.

SUBFAMILY ADUSTINAE.

Five genera are found in Western Australia. *Solvadusta* has a small blotch and speckles and rounded base, *Gratiadusta* has a less rounded base. *Palmadusta* is colour banded. *Cribraria*, represented by the "Mesh Cowry" *C. fallax*, has white spots in a brown mesh, while an extraordinary species, *C. exmouthensis*, has the mesh pattern somewhat obscured. *Albacypraea* is white.

SUBFAMILY NARIINAE.

There are two genera, *Paulonaria*, with a dotted pattern, and *Evenaria*, banded. Both are found in N.W.A.

SUBFAMILY MAURITIINAE.

The first genus, *Mauritia*, is represented by the "Chocolate" or "Mauritius" Cowry, *Mauritia mauritiana* of N.W.A. and central Indo-Pacific, a thick, heavy shell with dark brown to almost black reticulations on its back. The "Arabic Cowry," *Arabica arabica*, has a beautiful medium-sized, dark brown shell, with intricate arabic markings on the back, and a close relative is the "Reticulate Cowry" *A. westralis*. Other species are the more elongate *A. perconfusa*, the smaller *A. scurra*, and also *A. depressa*, all found in N.W.A.

SUBFAMILY EROSARIINAE.

This is a sub-family of small Cowries, some of the species being very prolific. Four genera may be found in N.W.A., and two, *Erosaria* and *Ravitrona*, in S.W.A. as well. *Erosaria* and *Ravitrona* have a spotted colour pattern, the latter being a dark brown shell, of which the "Serpent's Head Cowry," *R. caputserpentis*, is an example. The "Money Cowry," *Monetaria moneta*, varies from a deep yellow to white, but has no colour pattern. The "Ringed Cowry," *Ornamentaria annulus scutellum*, is encircled by a deep red or orange ring. Some specimens have two and even the part of a third ring. Very small adult dwarfs of both species are found off various Pacific Islands.

SUBFAMILY CYPRAEINAE.

These are the typical Cowries, the type specimens being the pretty and plentiful "Tiger Cowry," *Cypraea tigris*. The "Lynx Cowry," *Lyncina lynx*, the "Egg Yolk Cowry," *Mystaponda vitillus*, the "Map Cowry," *Leporicypraea mappa*, and the "Pink-banded Cowry," *Ponda carneola sowerbyi*, a flesh-coloured pink-banded shell, all from N.W.A., complete the list of Western Australian species.

The following is a complete list of W.A. Cowries and their relatives:—

ERATOIDAE.

Lachryma Sowerby 1832. *Erato lachryma* Sowerby 1832.
denticulata (Pritchard & Gatliff) 1900. Vict. (type), Tas., S.A., S.W.A.
Cypraerato Schilder 1932. *Erato bimaculata* Tate 1878.
bimaculata (Tate) 1878. S.A. (type), Tas., S.W.A.

TRIVIIDAE

Trivirostra Jousseaume 1884. *Cypraea scabriuscula* Gray 1827.
oryzoides Iredale 1935. N.W.A. (type).
= *Trivia oryza* Odhner 1917. Not *oryza* Lamarck.
paragrandо Iredale 1935. N.W.A. (type).
= *Trivia grandо* Odhner 1917. N.W.A. (type).
Dolichupis Iredale 1930. *Cypraea producta* Gaskoin 1836.
obscura (Gaskoin) 1849. N.W.A. (type).
= *Trivia bipunctata* (Odhner) 1917. N.W.A. (type).
Cleotrivia Iredale 1930. *Cypraea pilulu* Kiener 1845.
bathypilula Iredale 1935. S.W.A. (type).
= *Trivia globosa* Verco 1918, not Gray.
Ellatrivia Iredale 1931. *Triviella merces* Iredale 1924.
merces (Iredale) 1924. N.S.W. (type), Vict., Tas., S.A., S.W.A.
= *Cypraea australis* Lamarck 1822. Not Schoeter 1804.

AMPHIPERATIDAE
SUBFAMILY AMPHIPERATINAE.

Amphiperas Meuschen 1781. *Bulla ovum* Linne 1758.
ovum (Linne) 1758. Amboina (type), N.A., Q., N.S.W.
Pellasimnia Iredale 1931. *Ovulum angasi* Reeve 1865.
verconis (Cotton and Godfrey) 1932. S.A. (type D.13476, S.A. Mus.), S.W.A.
depressa (Sowerby) 1875. N.W.A. (type).

SUBFAMILY VOLVINAE.

Volva Bolten 1798. *Bulla volva* Linne 1758.
= *Radius* Montfort 1810 = *Birostra* Swainson 1840.
volva (Linne) 1758. Q., N.W.A., N.A.
= *Volva textoria* Bolten 1798.
Phenacovolva Iredale 1930. *Phenacovolva nectarea* Iredale 1930.
haynesi (Sowerby) 1889, N.W.A. (type).
praenominata Iredale 1935. N.W.A. (type).
= *Radius gracillimus* Schilder 1927, not Smith 1901.
exsul Iredale 1935. S.W.A. (type).
= *Ovula philippinerum* Verco 1912.

CYPRAEIDAE

SUBFAMILY PUSTULARIINAE.

Pustularia Swainson 1840. *Cypraea cicercula* Linne 1758.
globulus (Linne) 1758. N.W.A.

SUBFAMILY STAPHYLAEINAE.

Staphylaea Jousseaume 1884. *Cypraea staphylaea* Linne 1758.
staphylaea (Linne) 1758. Mauritius (type), Q., N.S.W., N.A., N.W.A.
Nucleraria Jousseaume 1884. *Cypraea nucleus* Linne 1758.
nucleus nucleus (Linne) 1758. N.W.A., Q., N.A.

SUBFAMILY UMBILINAE.

Umbilia Jousseaume 1884. *Cypraea umbilicata* Sowerby 1825.
hesitata armeniaca (Verco) 1917. S.W.A. (type).

SUBFAMILY ZOILINAE.

Zoila Jousseaume 1884. *Cypraea friendi* Gray 1831.
friendi friendi (Gray) 1831. S.W.A., Swan River (type).
= *Cypraea scotti* (Broderip) 1832.
friendi vercoi Schilder 1930. S.W.A., Esperance (type D.14124, S.A. Mus.).
thersites thersites (Gaskoin) 1848. S.A. (type).
= *Cypraea marginata* Gaskoin 1848.
thersites contraria Iredale 1935. S.W.A. (type). Deep water.
thersites venusta (Sowerby) 1847. N.W.A. (type).
= *Cypraea thatcheri* Cox 1869.
= *Cypraea bakeri* Gatliff 1916.
= *Cypraea brunnea* Cox 1889.
thersites episema Iredale 1939. S.W.A. (type).
decipiens (Smith) 1880. N.W.A. (type).
rosselli (Cotton) 1948. S.W.A., Fremantle (type D.14220, S.A. Mus.).

SUBFAMILY CYPRAEOVULINAE.

Notocypraea Schilder 1927. *Cypraea piperita* Gray 1825.
piperita (Gray) 1825. S.A. (type), S.W.A., N.S.W., Vict., Tas.
bicolor (Gaskoin) 1849. Tas. (type), Vict., S.A., S.W.A., N.S.W.
mayi (Beddome) 1898. Tas. (type), S.A., S.W.A., N.S.W., Vict.
declivis occidentalis Iredale 1935. S.W.A., Geographe Bay (type), N.W.A.
subcarnea (Beddome) 1896. Tas. (type), S.A., S.W.A., N.S.W., Vict.
= *Cypraea albata* Beddome 1897.
verconis Cotton and Godfrey 1932. S.A. (type D.13474, S.A. Mus.), S.W.A., N.W.A., N.S.W., Vict.
Guttacypraea Iredale 1935. *Cypraea pulicaria* Reeve 1846.
pulicaria (Reeve) 1846. S.W.A. (type), S.A.
= *Guttacypraea pulicaria candida* Coen 1949.
euclia Steadman & Cotton 1946. S.W.A., 100 fms., 40 miles W. of Eucla (type D.11634, S.A. Mus.).

SUBFAMILY AUSTROCYPRAEINAE.

Austrocypraea Cossmann 1903. *Cypraea contusa* McCoy 1877 (fossil).
= *Prolyncina* Schilder 1927. *Cypraea reevei* Sowerby 1832 (recent).
reevei (Sowerby) 1832. S.W.A. (type), S.A.

SUBFAMILY TALPARIINAE.

Talparia Troschel 1863. *Cypraea talpa* Linne 1758.
talpa (Linne) 1758. Amboina (type), N.W.A.
Basilitrona Iredale 1930. *Cypraea isabella* Linne 1758.
isabella isabella (Linne) 1758. N.W.A., Q., N.S.W., N.A.
= *Basilitrona isabella rumphi* Schilder and Schilder 1939.
Arestorides Iredale 1930. *Cypraea argus* Linne 1758.
argus argus (Linne) 1758. N.W.A.
= *Cypraea argus contrastriata* (Perry) 1811.

SUBFAMILY ERRONEINAE.

Erronea Troschel 1863. *Cypraea erronea* Linne 1758.
nimisserans nimisserans Iredale 1935. Q. (type), N.S.W., N.A., N.W.A.
nimisserans coxi (Brazier) 1872. N.W.A., Depuch Is. (type).
magerrones proba Iredale 1939. N.W.A. (type), N.A.
Palangerosa Iredale 1930. *Cypraea cylindrica* Born 1780.
cylindrica sista Iredale 1939. N.W.A. (type).
Ovatipsa Iredale 1931. *Cypraea chinensis* Gmelin 1791.
caurica blaesa Iredale 1939. N.W.A. (type), N.A.
chinensis variolaria (Lamarck) 1810. Amboina (type), N.W.A.
Blasicrura Iredale 1930. *Cypraea rhinoceros* Souverbie 1865.
irvineanae (Cox) 1890. S.W.A., Cape Naturalist (type).
Bistolida Cossmann 1930. *Cypraea stolida* Linne 1758.
stolida stolida (Linne) 1758. Ceylon (type), Broome, N.W.A
quadrimaculata (Gray) 1824. Amboina (type), N.W.A., N.A.

SUBFAMILY ADUSTINAE.

Palmadusta Iredale 1930. *Cypraea clandestina* Linne 1758.
clandestina (Linne) 1767. N.W.A. (type).
lutea bizonata Iredale 1935. N.W.A. (type).
Gratiadusta Iredale 1930. *Cypraea pyriformis* Gray 1825.
pyriformis pyriformis (Gray) 1825. N.W.A., Q., N.A. (type).
pyriformis smithi (Sowerby) 1881. N.W.A. (type).
kaiseri (Kenyon) 1897. N.W.A. (type), N.A., Q.
walkeri comptoni (Gray) 1847. N.A. (type), N.W.A.
Solvadusta Iredale 1935. *Gratiadusta vaticina* Iredale 1930.
subviridis subviridis (Reeve) 1835. N.Q. (type), N.A., N.W.A.
= *Adusta dorsalis* Schilder & Schilder 1938.
Albacypraea Cotton & Steadman 1946. *Cypraea eburnea* Barnes 1828.
eburnea (Barnes) 1828. Fiji (type), Manus, New Guinea, Q., N.A.
N.W.A.
Cribraria Jousseaume 1884. *Cypraea cribraria* Linne 1758.
cribraria fallax (Smith) 1881. N.W.A., S.W.A.
cribararia exmouthensis (Melvill) 1888. N.W.A. (type).

SUBFAMILY NARIINAE.

Paulonaria Iredale 1930. *Cypraea beckii* Gaskoin 1836.
= *Opponaria* Iredale 1939. = *Cupinota* Iredale 1939.
macula hilda Iredale 1939. N.W.A., Shark Bay (type).

Evenaria Iredale 1930. *Cypraea asellus* Linne 1758.
asellus (Linne) 1758. Amboina (type), N.W.A., N.A.
punctata carula Iredale 1939. N.A., Q. (type), N.W.A.
hirundo cameroni Iredale 1939. N.A. (type), N.W.A., Q., N.S.W.

SUBFAMILY MAURITIINAE.

Mauritia Troschel 1863. *Cypraea mauritiana* Linne 1758.
mauritiana regina (Gmelin) 1791. N.W.A., Central Indo-Pacific.
Arabica Jousseaume 1884. *Cypraea arabica* Linne 1758.
arabica arabica (Linne) 1758. N.A., N.W.A., Q.
arabica westralis Iredale 1935. N.W.A. (type), N.A., Q.
eglantina perconfusa Iredale 1935. N.W.A. (type), N.A., Q.
scurra scurra (Gmelin) 1791. N.W.A., N.A., Q.
= *Cypraea indica* Gmelin 1791.
= *Cypraea amarata* Morch 1852.
depressa depressa (Gray) 1824. N.W.A., N.A., Q.
= *Cypraea intermedia* Redfield 1847.
= *Cypraea gillei* Jousseaume 1893.

SUBFAMILY EROSARIINAE.

Erosaria Troschel 1863. *Cypraea erosa* Linne 1758.
erosa phagedaina (Melvill) 1888. N.W.A., S.W.A.
inocellata diversa (Kenyon) 1902. N.W.A., Shark Bay (type D.3903, S.A. Mus.).
Ravitrona Iredale 1930. *Cypraea caputserpentis* Linne 1758.
caputserpentis caputserpentis (Linne) 1758. N.W.A., S.W.A., N.S.W., Q., N.A.
caputserpentis kenyonae Schilder & Schilder 1919. N.W.A. (type).
helvola citrinicolor Iredale 1935. N.W.A. (type).
wilhelmina (Kenyon) 1897. N.W.A. (type D.14447, S.A. Mus.).
Monetaria Troschel 1863. *Cypraea moneta* Linne 1758.
= *Aricia* Broderip 1837.
moneta moneta (Linne) 1758. N.W.A.
moneta rhomboides Schilder & Schilder 1933. N.W.A. (type).
Ornamentaria Schilder & Schilder 1936. *Cypraea annulus* Linne 1758.
annulus scutellum Schilder & Schilder 1937. N.W.A.

SUBFAMILY CYPRAEINAE.

Cypraea Linne 1758. *Cypraea tigris* Linne 1758.
tigris tigris Linne 1758. N.W.A. (type), N.A., Q.
Lyncina Troschel 1863. *Cypraea lynx* 1758.
lynx lynx (Linne) 1758. N.W.A., Q.
= *Cypraea vanelli* Linne 1758.
= *Cypraea michaelis* Melvill 1905.
Mystaponda Iredale 1930. *Cypraea vitellus* Linne 1758.
vitellus vitellus (Linne) 1758. N.W.A., N.A., S.W.A., N.S.W.
= *Cypraea distorta* Cox 1889. preocc.
Leporicypraea Iredale 1930. *Cypraea mappa* Linne 1758.
mappa mappa (Linne) 1758 N.W.A., N.A., Q.
= *Mauritia geographica* Schilder & Schilder 1934.

Ponda Jousseaume 1884. *Cypraea ventriculus* Lamarck 1810.
carneola sowerbyi (Anton) 1839. N.W.A.
= *Cypraea loebbeckeana* (Weinkauff) 1881.

PLATE 2.

Umbilia hesitata armeniaca (Verco).
Zoila thersites episema Iredale.
Zoila decipiens (Smith).
Zoila friendi vercoi Schilder.
Zoila friendi (Gray).
Zoila rosselli Cotton.

PLATE 3

Nucleania nucleus (Linne).
Guttacypraea pulicaria (Reeve).
Notocypraea occidentalis Iredale.
Notocypraea piperita (Gray).
Notocypraea verconis Cotton & Godfrey.
Austocypraea reevei (Sowerby).

PLATE 4.

Basilitrona isabella (Linne).
Arestorides argus (Linne).
Erronea nimisserans Iredale.
Palangerosa cylindrica sista Iredale.
Solvadusta subviridis (Reeve).
Cribraria cribraria exmouthensis (Melvill).

PLATE 5.

Mauritia mauritiana regina (Gmelin).
Arabica scurra (Gmelin).
Ravitrona caputserpentis kenyonae Schilder & Schilder.
Cypraea tigris Linne.
Mystaponda vitellus (Linne).
Ponda carneola sowerbyi (Anton).

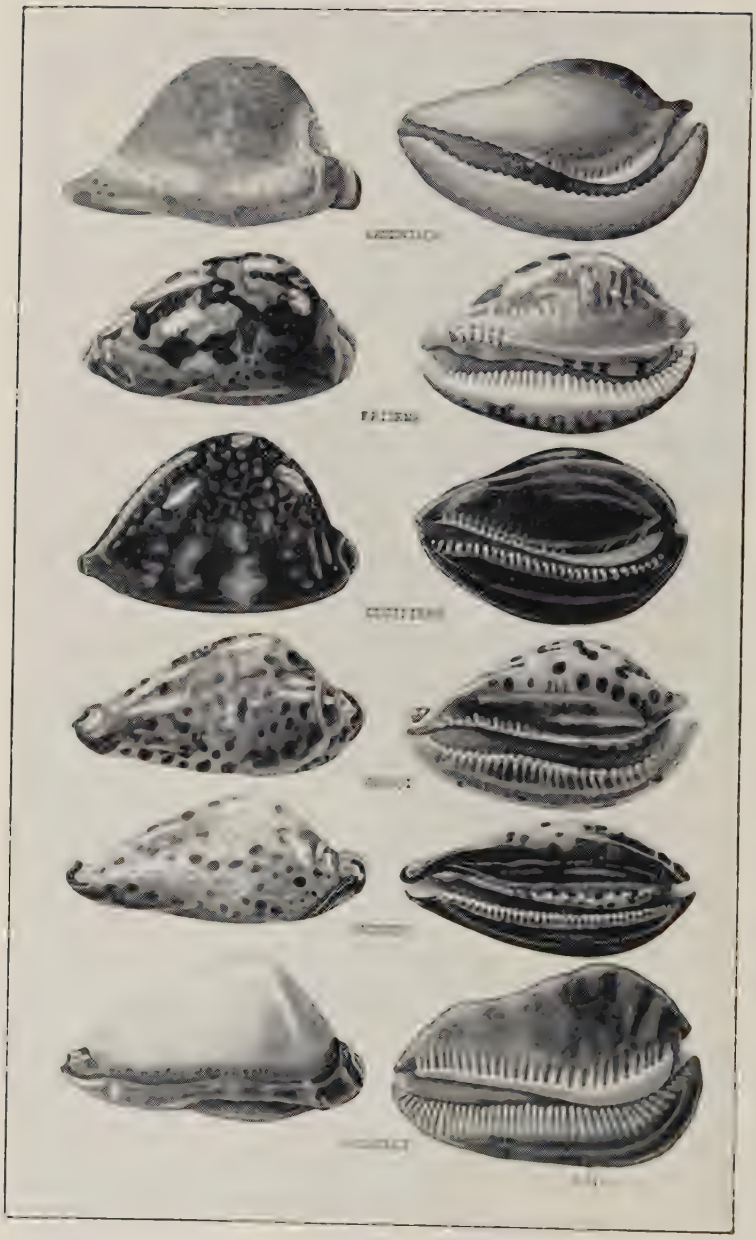


Plate 2

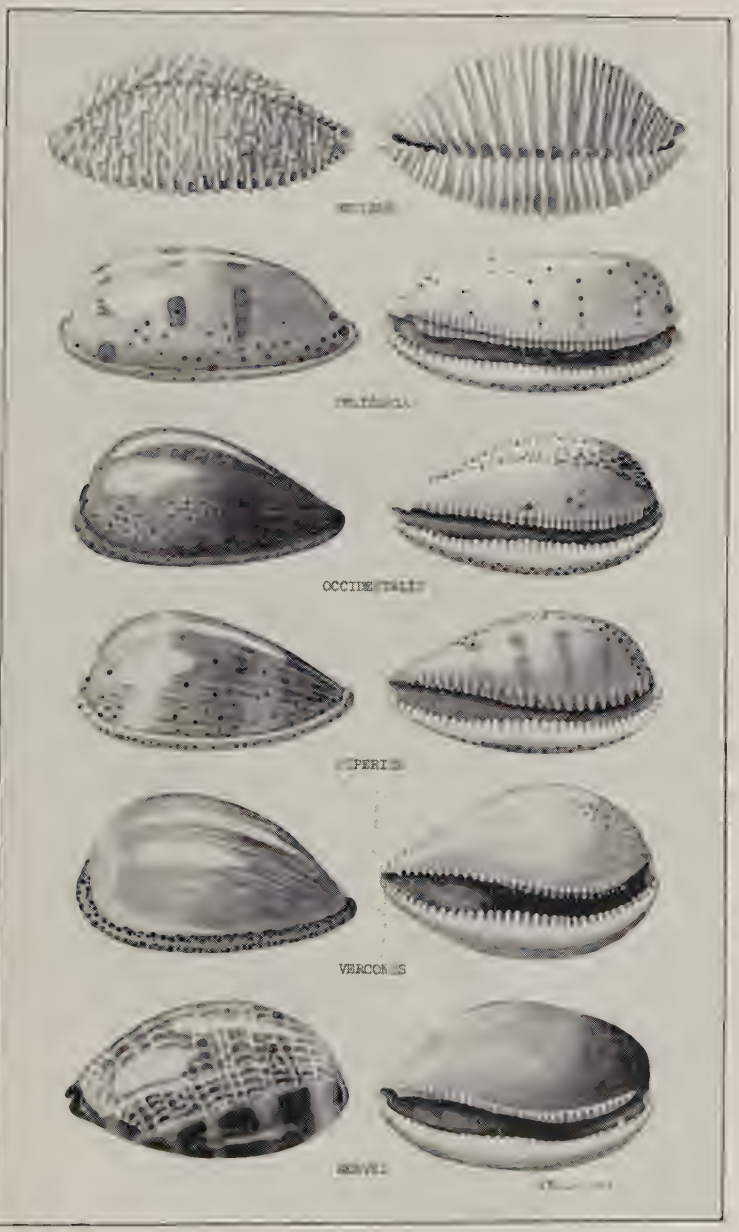


Plate 1.

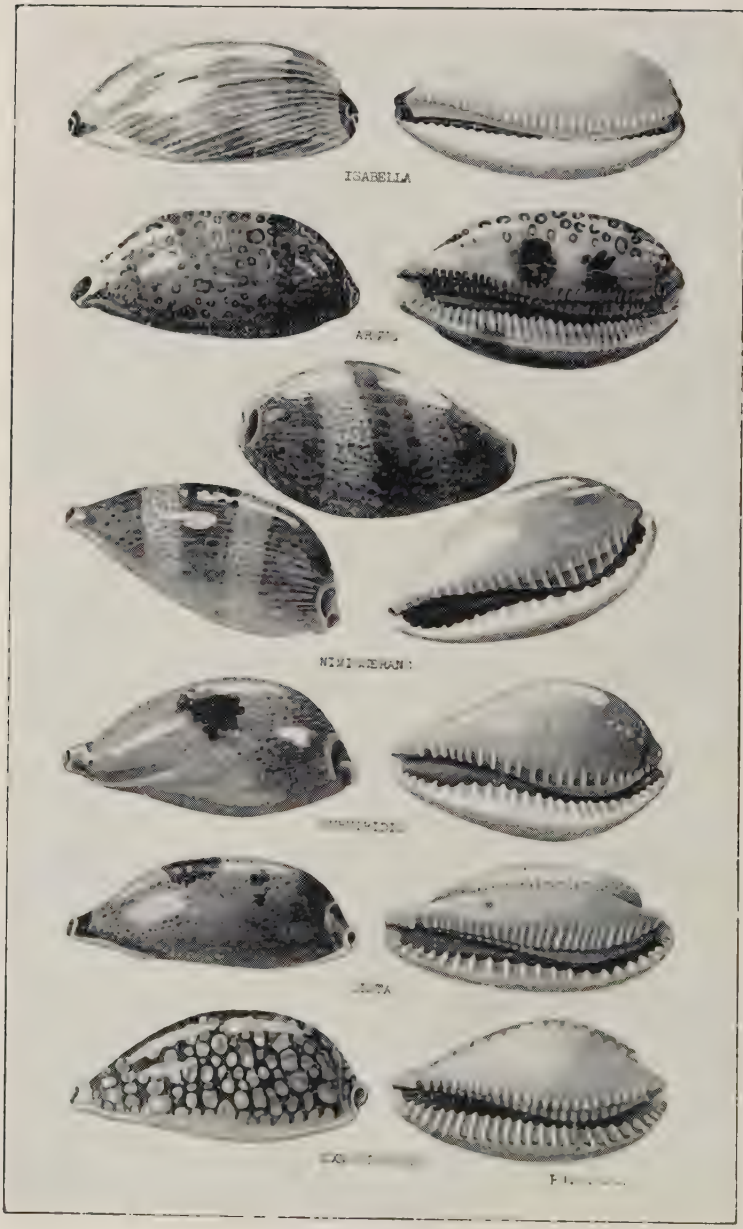


Plate 4

Plate 5.

FURTHER VICTORIAN OPISTHOBRANCHIA

By ROBERT BURN*

(Read 31st March, 1958)
(Plates 6-7; Text figures 1-9)

INTRODUCTION

This is the third paper of a series to be published concerning Victorian Opisthobranchia. The first two appeared in the latter half of 1957 and dealt with 36 species, a number of which were described as new. This paper deals with 15 species, of which 12 are new records for this State; one new genus is proposed for the reception of a quite common species, and 9 species are described for the first time. This brings the list of Victorian Opisthobranchia to 48 species divided among 32 genera.

The localities from which all species have been collected are in the recently proposed Victorian Maugean Region, but within the Peronian influence. This has apparently been the reason why a number of species described from Sydney Harbour, New South Wales, by Angas (1864) are quite common here. But some of these species of Angas' are rare in their type locality and have been seen only once or twice over the intervening years since description. These species, i.e., *Praegliscita chrysoderma* (Angas), *Madrella sanguinea* (Angas), *Melibe australis* (Angas) and *Paliolla cooki* (Angas) are rather common at most localities at which collecting has been undertaken by this author.

Could it be that the Peronian Region is somewhat influenced by this Victorian Maugean Region, and was it at one of these times that Angas collected his species?

Two species recorded here were first described from European waters, one of which is also recorded from Japan. The other is quite remarkable for its most peculiar rhinophoral construction. The species of *Elysia* here described as new is the third of its genus from Australia—surely this genus must occur in a number of species along our northern and western coastlines in tropical waters? As it is, the three species known all occur on our east or south-east coast.

Unless otherwise stated, all specimens of species described or recorded here were collected by the author.

The type specimen of each new species, along with specimens of other newly recorded species, are to be presented to the National Museum of Victoria, Melbourne.

The systematic position of the species dealt with in this paper can be set out as follows:—

* Geelong, Victoria, Australia.

(* Denotes species not previously recorded from Victoria.)

Class - - - GASTROPODA
Subclass - - OPISTHOBRANCHIA
Order - - - Anaspidea
Family - - - **APLYSIIDAE**
Aplysia hyalina Sowerby
Order - - - Sacoglossa
Suborder - - Elysiacea
Family - - - **ELYSIIDAE**
**Elysia furvacauda sp. nov.*
Order - - - Notaspidea
Suborder - - Pleurobranchacea
Family - - - **PLEUROBRANCHIDAE**
Pleurobranchaea maculatus (Quoy and Gaimard)
Order - - - Nudibranchia
Suborder - - Doridacea
Superfamily Eudoridacea
Group - - - Phanerobranchia
Family - - - **POLYCERIDAE**
**Palio parvula sp. nov.*
Paliolla cooki (Angas) *gen. nov.*
**Kaloplocamus ramosus* (Cantraine)
Family - - - **ACANTHODORIDIDAE**
**Lamellidoris maugeansis sp. nov.*
Family - - - **OKENIIDAE** (= Goniodorididae)
**Goniodoris meraculus sp. nov.*
Group - - - Cryptobranchia
Family - - - **DORIDIDAE**
**Hallaxa indecora* (Bergh)
**Rostanga hartleyi sp. nov.*
Alloiodoris nivosus sp. nov.
Platydoris galbanus sp. nov.
Suborder - - Arminacea
Superfamily ————
Family - - - ————
**Janolus hyalina* (Alder and Hancock)
**Proctonotus? affinis sp. nov.*
Suborder - - Dendronotacea
Family - - - **DOTONIDAE**
**Doto ostentus sp. nov.*

DESCRIPTIONS OF SPECIES

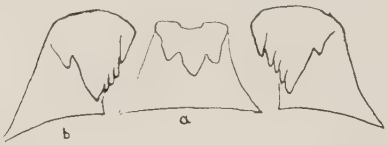
APLYSIA HYALINA Sowerby

(Text fig. 1)

Aplysis hyalina Sowerby 1869, *Conchyl. Icon.*, 17, pl. 4, sp. 13.

Body large, upwards of 200 mm.; parapodia large, separated behind. Mantle aperture closed with a strong papilla on the spot of the closure. Rhinophores and cephalic tentacles large, stout, and crenulate on the distal ends. With a large, strong purple gland. Radula formula 50 x 23.1.23. Median tooth small, cusp rounded, with one large denticle either side;

laterals large, triangular, with one large denticle either side and three smaller ones on the inner edge. Body-colour dark purple brown, with a few faint interlacing black lines on the outer surfaces of the parapodia and neck. The shell is large, 50 mm. long by 42 mm. broad, nearly flat, extremely thin and membranous; pale greenish-yellow in colour.



Text Fig. 1.
Aplysia hyalina Sowerby.
Single row of radula; a—central tooth, b—typical lateral tooth.

Localities: Rosebud (2 spec., May, 1954); Swan Bay (2 spec., April, 1955).

Station: Common, crawling on sand and weed in a few feet of water, low tide.

Remarks: This is the species referred to by the author (1957) as *A. tigrina* Rang = *A. sowerbyi* Pilsbry. Since then, however, a comparison of New South Wales and Victorian specimens have shown that the above is the correct name.

ELYSIA FURVACAUDA sp. nov.

(Pl. I, fig. 1)

Typical *Elysia*. Body limaciform, up to 19 mm. in length; parapodia narrow, extending along either side of body for more than three-quarters of total length. When closed together, the parapodia form two distinct holes along the mid-dorsal line; the anterior hole is nearly the width of the body in diameter, while the other is much smaller; rhinophores large, auriculate slightly involute. Anus emerges a little to the right of the median-line on the anterior edge of the pericardium, which is medianly placed just behind the anterior edges of the parapodia. Body colouring is dark red-brown, outer sides of parapodia speckled with numerous small pale blue spots. The parapodia margins, when together, form a blue mid-dorsal line outlined on either side by a line of interrupted white. Margins of holes plain white; upper anterior portion of each parapodia greyish-blue. Slender neck, pale pinkish-brown; base of the rhinophores and the neck spotted with white dots. Rhinophores and tail tipped with black.

Locality: Torquay (1 spec., Sept., 1957).

Station: Unique, under stone at mid-tide.

Remarks: While under observation this specimen showed certain colour changes over a period of 24 hours. The colours noted above were those when first collected. After 24 hours the body-colour was dull brown, with many more larger blue spots on the sides than previously; the anterior blue patch had become very intense. Unfortunately, after two days the specimen died, and when placed in spirits became pale pink, still with black tips, but with no trace of blue.

E. australis Quoy and Gaimard and *E. marginata* (Pease), from New South Wales, are both predominantly green in body-colour, which at once separates the present species from them.

PLEUROBRANCHAEA MACULATUS (Quoy and Gaimard)

Pleurobranchidium maculatus Quoy and Gaimard, 1832, *Voy. "Astrolabe." Zool* 2, p. 301, pl. 22. fig. 11-12.

= *Pleurobranchaea novaezealandiae* Cheeseman, 1878, *Proc. Zool. Soc., Lond.*, p. 276, pl. 15, fig. 3.

= *Pleurobranchaea dorsalis* Allan, 1933, *Rec. Aust. Mus.*, 18, No. 9, p. 445, pl. 56, fig. 4-5.

The above name was overlooked by the author when compiling the first list of Victorian Opisthobranchia; and in its stead *P. novaezealandiae* Cheeseman was used. From a quick glance at the figures and description of *P. maculatus* any species could be suggested to fit the name; but the type locality is Westernport Bay, Victoria. The description of *P. novaezealandiae* seemed to be closer to our species at the time, and this therefore was the name used.

Since that time, however, a further number of specimens have come to hand, including a large specimen from Flinders, Westernport Bay. These have led to a reconsideration of species, and the results are such that *P. maculatus* (Q. and G.) should be used, and that *P. novaezealandiae* Cheeseman is synonymous.

The other species of *Pleurobranchaea*, *P. dorsalis* Allan, recorded from New South Wales and Tasmania, is, from its description, undoubtedly the same species, although perhaps a warmer sea ecological variant. It has been observed that certain species become paler in colour as they move into colder waters, and, therefore, if this is so, then *P. dorsalis* can also be accepted as a synonym of *P. maculatus*.

Finally, if the above synonomy is accepted, then it would appear that *P. maculatus* is an inhabitant of the temperate and cool-temperate regions of the Pacific. It has been recorded as common in Japan and occurring in China by Baba (1949), and has been collected in New Zealand, New South Wales, Victoria and Tasmania.

Victorian localities for the species include Lorne, Apollo Bay, Queenscliff, Sorrento, and Flinders, Westernport Bay.

PALIO PARVULA sp. nov.

(Pl. I, fig. 2-3, text fig. 2)

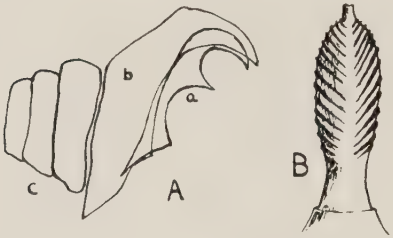
Very small limaciform animal, 9 mm. in length. Velar processes 2; large and digitiform. Pallial ridge consisting of a row of (8-9) broadly-spaced points along either side. Branchial plumes 5 in number; bipinnate, non-retractile. Anterior edge of branchial cavity with 7 low papillae placed evenly in a semi-circle. Rhinophores large, non-retractile, perfoliate. Oral tentacles indistinct, lobiform. Foot very narrow; sole pink, edged with orange; anterior corners rounded. Genital orifice large. Body-colour maroon, maculated with white. Velar processes dorsally orange, ventrally white. Pallial ridge points yellow; papillae anterior to branchiae bright red. Branchiae and rhinophores dark red. Radula formula 11 x 3.2.0.2.3. First lateral small, hamate, calcarate, spur large and half way down the inner side. Second lateral, hamate. Remaining 3 laterals simple, scale-like.

Locality: Torquay (1 spec., Dec., 1956; 2 spec., Oct.-Dec., 1957).

Station: Uncommon, under stones at low tide.

Remarks: This species is placed in the genus *Palio* Gray in preference to *Polycera* Cuvier as the nature of the velar processes and pallial ridge warrant it. *Palio* is generally accepted as a synonym of *Polycera* (or as a subgenus, if this name is used at all). The radula is typical of *Polycera*, and, while this alone can place a species in a genus, the external features in the author's opinion place the species in the genus *Palio*.

This species has as yet no congeners occurring in Australian waters.



Text fig. 2.
Palio parvula sp. nov.
A—half row of radula,, a—first lateral, b—second latertal, c—outer laterals,
B—rhinophore.

PALIOLLA gen. nov.

Animal polyceridiform; body limaciform, very soft, pallial ridge not prominent, consisting of a row of small pointed papillae. Branchial plumes few in number, bipinnate and sub-retractile. Branchial cavity crescentic, anterior lip strong. Rhinophores large, perfoliate, retractile. Radula degenerate; all that remains is a group of calcareous rods in the form of a long, slender tube. These are supported on either side by a further series of minute rods.

Type species: *Polycera cooki* Angas.

This genus is proposed for the reception of a single species *P. cooki* (Angas); the most unusual odontophore features being different from any other known genus. The number, form and shape of the rods make it impossible to formulate a normal radula. The supplementary rods on either side of the large ones may be the remains of a normal radula, or again may be the first signs of a radula with the subsequent decrease of the central tubiform portion.

Gymnodoris Stimpson, which has numerous branchiae, is very similar to *Paliolla*, a genus which has but a few. *Gymnodoris* has a divided hermaphrodite gland, which is formed into globules, but whether it is the same in *Paliolla* remains to be seen. It is worth noting that the outer lateral teeth of the radula in *Gymnodoris spp.* are long and slender, but on a broad base, so much so that there is actually a great similarity between them and the central rods in *Paliolla*.

Possibly *Paliolla* is an archaic genus in the phanerobranchiate Nudibranchia, as is *Gymnodoris*.

PALIOLLA COOKI (Angas)
(Pl. I, fig. 4; text fig. 3)

Polycera cooki Angas, 1864, *J. Conchyliol*, 12, p. 58, pl. 5.

Body small, limaciform, very soft; up to 17 mm. in length and 4 mm. in width. Pallial ridge comprising many small, soft papillae. Dorsum separated from sides by pallial ridge, but continuous into tail. Rhinophores large, clavate, perfoliate, with 8 very steep laminae. Branchiae 5 in

number, bipinnate, sub-retractile, arranged in a broad crescent. Branchial cavity with a strong anterior lip. Foot not as wide as body, square and grooved anteriorly. No oral tentacles, mouth a large pore in a depression just above the foot. Body-colour orange or yellow; entirely covered with minute strawberry-red dots; foot whitish. Pallial ridge red or white. Internally below the branchiae there is a large, bright pink mass.

Radula peculiar; tubiform, comprising 9 long, slender rods in three series. The first or anterior series—length about two-thirds of total—comprises 5 equal-length rods, the anterior ends rounded and curved outwards, providing a funnel-like inlet. The second series of two rods is placed medianly; length 1.3 mm.; anterior ends sharply pointed; posterior ends

Text fig. 3.
Paliolla cooki (Angas).
Complete radula.
a—central tubiform portion, b—minute supporting rods.

rounded. The third series, again of two rods, is placed at the posterior end of the tube, length same as second series; anterior ends sharply pointed; posterior ends broken and bent to one side. Total length of rods in largest specimen 2.5 mm. Laterally, at half length of the second series, are two wings, each of which has 7 minute rods parallel to each other, but at an angle of slightly less than 45 degrees to the main tube.

Localities: Breamlea (1 spec., Nov., 1955); Torquay (2 spec., Dec., 1955, 2 spec., Mar., 1957, 2 spec., Dec., 1957); Aireys Inlet (1 spec., April, 1957).

Station: Not uncommon, usually in pairs, under stones near low tide level.

Remarks: As can be seen from the remarkable buccal features, this species is indeed hard to place in any existing genus. Previously it has been placed in *Polycera* by Angas and in *Palio* by Bergh, although personally the author would have preferred to place the species in *Gymnodoris*. But the degenerate radula, while reminiscent of *Gymnodoris*, is sufficiently different as to allow the erection of a new genus.

KALOPLOCAMUS RAMOSUS (Cantraine)

Doris ramosus Cantraine, 1835, *Acad. Roy. Sci., Bruxelles,* Bull. No. 2, p. 383.

Length 22 mm.; body limaciform; head slightly broader than body; margin of head with 8 dendritic processes. Dorso-lateral processes dendritic, in 5 pairs. Branchiae 5 in number, bipinnate and non-retractile. Rhinophores clavate; clavus small and perfoliate; stalks very long and slender. Oral tentacles lobiform. Foot narrow, thickened anteriorly. "Radula formula at most 43 x 37.3.0.3.37. The first three laterals large, hamate; the rest scale-like" (Baba, 1949). Body-colour pale orange speckled with white, with a single row of white dots along either side. Clavus of rhinophores red, stalks clear; velar and dorso-lateral processes colourless. Branchiae either colourless or bright red, the latter with or without white tips.

Locality: Torquay (1 spec., Oct., 1957, 2 spec., Jan., 1958).

Station: Rare, under stones near low tide.

Remarks: This species is recorded from the Mediterranean (type locality) and Japan. The above specimens agreed exactly with the figure given by Baba (1949), *Opisthobranchia of Sagami Bay* (Tokio) pl. 13, fig. 47.

Triopa yatesi Angas, from Port Jackson, undoubtedly belongs to this genus, and may even be the same as the above species. Certain differences between the two species are easily seen, and until *T. yatesi* is again collected and studied its validity must remain in doubt.

LAMELLIDORIS MAUGEANSIS sp. nov.

(Pl. 2, fig. 8-9 text fig. 4)

Length 8 mm., breadth 5 mm. Doridiform body, dorsal surface covered with a multitude of blunt-pointed papillae; height upwards of 2 mm.; retracted they appear as low, stud-like pustules. Integument of mantle densly spiculose; spiculae of many forms, some simple, some divided and some calcarate. Rhinophores claviform, with 4 large oblique laminae, retractile. Margins of rhinophore openings smooth. Branchiae 4 in number, simply pinnate, arranged in a shallow horseshoe crescent in front of the anal papilla. Branchial cavity transversely oval. Head broad, crescent shaped, with the extremities formed into stout digitiform processes. Mouth large. Foot broad anteriorly and tapers sharply to a blunt tail—does not extend beyond mantle margin. Body-colour orange-yellow, foot clear. Ventrally the mantle is transparent, and the silver and gold spiculae are very visible when viewed with a low-power lense. Rhinophores and branchiae faintly yellow, with openings rimmed with gold. The liver forms a very dark mass on the posterior left side. Radula too small

Text fig. 4.
Lamellidoris maugeansis sp. nov. A—Rhinophore viewed from side and front. B—mantle spiculae, 4 forms.

for examination by the author, but there was seen to be 22 rows of teeth. Labial armature not noticed, although a small amount of oral cuticle was present.

Localities: Torquay (8 spec., Oct.-Nov., 1957, type locality); Breamlea (1 spec., Jan., 1958).

Station: Not uncommon, under stones at low tide. Usually in crevices or holes where a certain amount of mud accumulates.

Remarks: Very hard to find, as the body-colour usually blends with the muddy background; often in colonies of numerous individuals.

This species has no congeners in Australian waters, but a closely allied genus, *Acanthodoris*, occurs in Tasmania.

GONIODORIS MERACULUS sp. nov.
(Pl. 2, fig. 10-11)

Body stoutly limaciform, angular; length 17 mm. Dorsal surface smooth, half as broad as foot anteriorly, and a little broader near the branchiae. Pallial margin a very thin, narrow, rim-like flange, minutely crenulate and roughened, continuous all round except behind the branchiae. Rhinophores linear-clavate, perfoliate, with 12 or more very fine laminae; situated extremely close to the anterior pallial ridge. Branchiae large, bipinnate, 7 in number, all joined at the base and arising not from a cavity, but from the dorsal surface surrounding the large anus. Foot broad, flat, minutely flecked with white, square in front, with a wide notch below the head. Tail ridged from behind branchiae to tip. Head large, produced well forward and sideways; orals linear; a low ridge from pallial rim to edge of head; eyes visible as black dots either side of the head ridge. Mouth a vertical slit; jaws occasionally visible as two brown plates inside the mouth. Radula not examined. Genital orifice a large elliptic pore behind the line of the rhinophores. Body-colour pale greenish-yellow, heavily maculated with white. Region around branchiae pink, internally black. Rhinophores with brown stalks and yellow clavi; branchiae clear or pale pink; pallial rim yellowish. Underside of head around mouth dark brown.

Locality: Torquay (1 spec., Dec., 1957).

Station: Most rare, nested in a shallow depression on a species of slimy encrusting sponge under a stone at low tide.

Remarks: When first observed alive, this species appeared to be a yellowish sea-anemone, around which some sponge growth had encroached. The author poked the "anemone" to see if it would retract. It did not retract, so it was scooped up with a knife and placed in a jar of water, where it immediately came to life. The specimen remained alive for several days before being placed in spirits. It is interesting to note that, when first picked up, the specimen had its foot edges curled up to the pallial rim, and the underside was an exact caste of the depression in the sponge.

This species is very similar to all species of the genus *Goniodoris* Forbes and Goodsir (1839), but in being smooth-skinned it is easily differentiated. Although the genus *Goniodoris* is known to occur in New Zealand, this is the first record from Australia.

HALLAXA INDECORA (Bergh)

Halla indecora Bergh, 1905, *Siboga-Exped.*, Monogr. 50, p. 116, pl. 15, fig. 3-6.

Small, length up to 11 mm. Dorsal surface smooth, although velvet-like in appearance when alive. Rhinopore-clavus bulbous, perfoliate, with 5 or 6 laminae, retractile. Branchiae 10 in number, simply pinnate, retractile and in a complete circle surrounding the anus. Foot narrow, very deeply sinuated anteriorly, the extended corners possibly acting as orals. No projecting head and no oral tentacles. The mouth has two darker patches above it in the form of an inverted V—these, perhaps, are degenerate orals. Body-colour pale yellow, rhinophores and branchiae similar in colour. Radula not examined; Baba (1949) states, after examining two specimens, "18 x 6.1.0.1.6 and 20 x 7-8.1.0.1.7-8. First lateral large and broad, bicuspidate at tip. All succeeding laterals narrow and knife-shaped, with a series of 9-11 denticles on the edge." O'Donoghue (1929) describes a radula with teeth corresponding to those stated by Baba above, but says that there are 33 rows of teeth, 7.1.0.1.7.

Locality: Torquay (1 spec., Jan., 1958).

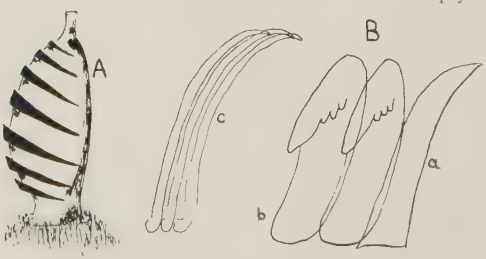
Station: Rare, crawling on a specimen of the echinoderm *Halopneustes inflatus*, although it is quite possible that it had just crawled on to this from surrounding seaweed.

Remarks: A most remarkable small doridiform animal easily indentified by the lack of orals and a sinuate foot. The pale colour is apparently unusual, normal colouring being in the grey or red-purple groups. This species is recorded from the East Indies, the Red Sea from Suez and Aden, Japan, and now Australia.

ROSTANGA HARTLEYI sp. nov.

(Pl. 2, fig. 12-13; text fig. 5)

Up to 40 mm. in length and 20 mm. in breadth. Body-shape roughly rectangular, with rounded corners, somewhat narrower at about half its length. Mantle covered everywhere with closely-set villous papillae as in *R. arbutus* (Angas); but here the papillae are much finer, slender, longer and closer together. Rhinophores clavate, perfoliate, with 7 or 8 large laminae, retractile; rhinophore-sheaths large. Branchiae 10 in number, bipinnate, set in a complete circle around the anus; retractile within a large circular cavity. Branchial-cavity with a very large sheath, margin finely crenulate. Head small, not prominent; orals very long and slender. Foot broad, flat, thickened and nearly square anteriorly; upper lamina deeply notched. Body colour pale pink or buff, with 3 to 5 large brown patches on either side of the median line; each patch encircled by a faint ring of white papillae. Rhinophores and branchiae white tipped. Radula formula 22 x 18—22.0.18—22. First lateral simply hamate without denticles;



Text fig. 5.
Rostanga hartleyi sp. nov.
A—detail of rhinophore.
B—half row of radula;
a—inner lateral,
b—median laterals,
c—outer laterals.

succeeding 12 laterals hamate, with a series of 3 denticles on the inner edge of each; outermost laterals slender, very closely set.

Localities: Sutherlands Bay, Phillip Island (3 spec., Jan., 1957); Flinders (2 spec., Dec., 1955); Torquay (2 spec., Sept., 1957); Breamlea (1 spec., Jan., 1958, type locality).

Station: Not common, under stones and crawling on seaweed in rock pools at low tide.

Remarks: Very similar to *R. arbutus* (Angas), but the points of difference are consistent. These differences can best be seen by the following key to the two species:—

R. arbutus (Angas).

1. Small body, flat in section, 30 mm. or less in length, breadth more than half length.
2. Rhinophores with numerous small laminae.
3. Head with short digitiform orals.
4. Radula 60 x 50-60.0.50-60; inner lateral finely denticulate, succeeding laterals simply hamate.

R. hartleyi mihi.

1. Large body, convex, over 30 mm. in length, breadth equals half length.
2. Rhinophores with 7 or 8 large laminae.
3. Head with very long orals.
4. Radula 22 x 18-22.0.18-22; inner lateral simply hamate, succeeding laterals denticulate.

It would appear as though *R. hartleyi* is the Flindersian representative of this genus. The author has in his possession a single specimen of this species collected at Coobowie, South Australia, by Mrs. T. W. Hartley of Melbourne, after whom the species is named.

ALLOIODORIS NIVOSUS sp. nov.

(Pl. 2, fig. 14; text fig. 6)

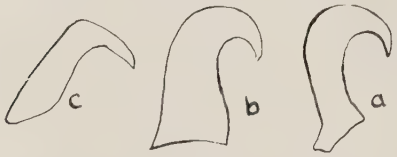
= *A. marmorata* Burn, 1957, *J. Malac. Soc. Aust.*, No. 1, p. 19, non Bergh, 1904.

Body-shape broadly elliptic, length up to 30 mm. and width up to 22 mm., rather flat. Dorsal surface entirely covered with minute spiculate papillae making it coarse to the touch and matt in appearance. Mantle much broader than foot, margin subcrenulate. Rhinophores clavate, finely perfoliate, retractile within low-sheathed cavities which have crenulate margins. Branchiae 7 in number, tripinnate, retractile within a broadly-oval transverse aperture; surroundng anus. Foot narrow, anteriorly notched and grooved. Head large, rounded; orals digitiform. Genital orifice large, appears as a longitudinal slit, situated a little behind the line of the rhinophores. Body-colour pure white, sometimes margined with brown; a number of dark brown spots on the sole, underside of mantle and sides of foot. Rhinophores brown; branchiae white, tipped with brown. Radula formula 37-40 x 18-19.0.18-19. First lateral quite large, a very strongly-curved spine on a short base. Median laterals larger, spines gradually decreasing in size towards the outside. Outer laterals falciform, not denticulate, and much smaller than inner laterals. Labial armature weak, but there is a large, strong oral cuticle.

Localities: Portarlington (many spec., 1954-1956); Sutherlands Bay, Phillip Island (6 spec., Jan., 1957); Shoreham (1 spec., Nov., 1957; type locality).

Station: Common under stones between tides, usually in muddy positions.

Remarks: The body-colour in some specimens is light grey, dorsally darker; mantle with numerous dark brown ring-like circles, in the centre of which is a pure white spot.



Text fig. 6.
Alloiodoris nivosus sp. nov.
Half row of radula; a—first lateral, b—typical median lateral, c—outer lateral.

This species has previously been recorded under the name of the Tasmanian species, A. *marmorata* Bergh (1904). Externally some specimens resemble A. *marmorata* as figured by Basedow and Hedley (1905—pl. 8, fig. 1-2). A. *marmorata* Bergh is a much larger species than A. *nivosus mihi*, and has quite a different radula, both in the teeth and the formula, the former being 34-35 x 40-42.0.40-42, with the outer teeth denticulate; the latter is 37-40 x 18-19.0.18-19 without any denticulate teeth.

Apparently A. *marmorata* Bergh is the Tasmanian or true Maugean representative of the genus, and A. *nivosus mihi* the Victorian form. But now arises the question: What is the correct name of the South Australian species recorded as A. *marmorata* Bergh by Basedow and Hedley? O'Donoghue (1924), when describing his species, A. *hedleyi* from the Abrolhos Islands, claimed his species to be identical with South Australian specimens, probably basing his claim on Basedow and Hedley's statement that their specimens did not have denticulate outer teeth. But A. *nivosus* is similiar to A. *hedleyi* in that it has no denticulate teeth, and therefore South Australian specimens have equal claim to either name. Also because the similarity between living Victorian specimens and the figures of those from South Australia is so much so that the author would prefer to use the name A. *nivosus* for the specimens from the Eastern Flindersion Region until, that is, specimens from there can be examined.

PLATYDORIS GALBANUS sp. nov.

(Pl. 1, fig. 6-7; text fig. 7)

Body small, length 40 mm., breadth 24 mm. Body-shape broadly elliptic, rather flat. Mantle leathery to the touch, minutely granular all over; expanded well beyond the foot. Branchiae very large and bushy; quadripinnate 5 in number, with the anus protruding between the rear pair. Branchial cavity margin consists of 5 broad, indistinct valves. Margins of rhinophore-sheaths crenulate. Rhinophores small, clavate; clavus apparently narrower than stalk, perfoliate, with 10 steeply-angled laminae. Oral tentacles digitiform, head rounded. Foot narrow, grooved anteriorly, not extending beyond posterior margin of mantle. Genital orifice large,

at the right-anterior third; male portion protruding from the anterior side; nephroproct on upper anterior side of genital orifice. Body-colour yellow, of a very bright hue; mantle with a few medium-sized white spots. Rhinophores and branchiae chocolate-brown. Radula formula 18 x 30.0.30. All lateral teeth large, simply hamate.

Text fig. 7.
Platydoris galbanus sp. nov.
Single typical lateral tooth of radula.

Locality: Sutherlands Bay, Phillip Island (2 spec., Jan., 1957).

Station: Rare, under a block of "blue clay" in a muddy position at low tide.

Remarks: A beautiful and distinctive species with no congeners in southern Australian waters. A number of species occur in northern tropical waters, and, while all are somewhat similar to the above, none agree exactly with the above description or colour.

JANOLUS HYALINA (Alder and Hancock)

Antiopa hyalina Alder and Hancock, 1854, *Mon. Brit. Nudi. Moll.*, Pt. 6, family 3, pl. 44, fig. 8-12.

Body small, stoutly aeolidiform; up to 17 mm. in length. Entire mantle margin set with 4 rows of closely-set branchial papillae. Branchial papillae roughly ensiform, rather flat, nodulose all round on the upper half; largest medianly in the inner row. Rhinophores with a large nautiloid-like crest between the bases; each is conical-clavate, perfoliate, non-retractile; eyes visible just behind the rhinophores. Anus protrudes posteriorly on the mid-dorsal line of the dorsum, well inside the branchial papillae. Genital orifice large, consisting of a circular pore on the posterior side. From the outer leading edge of this pore arises a short stalk, which has a bulbous distal end. Head small; orals digitiform, at right angles to the mid-dorsal line; mouth a longitudinal slit. Foot broad, flat, slightly hollow on the anterior edge, extending well beyond posterior margin of dorsum into a pointed tail which has a bare crest. Body-colour fawn; dorsum orange spotted. Branchial papillae fawn; ramifications dark brown. Radula not examined.

Locality: Torquay (2 spec., Jan., 1958).

Station: Rare, under rocks in mid-tide pools.

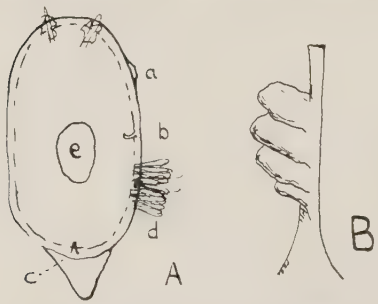
Remarks: Eliot (1910) states that the radula formula is 15 x 11-13.1. 11-13, but his figures of the species differs in some ways to those given by Alder and Hancock in their original description. My specimens agree extremely well with the original description and figures, and therefore I have used the above name in preference to creating a new species.

Unfortunately, the correct systematic position of this and the next species are unknown to the author from lack of literature on the subject. Therefore, while the sub-order is known, the super-family and family are left blank until further information is gained.

This and the next species might easily be confused when collected together, but this species, *J. hyalina*, is darker in colouring and has a most distinctive crest between the rhinophores, which the next species lacks. The type locality of this species is Cheshire, England.

PROCTONOTUS? AFFINIS sp. nov.
(Pl. 2, fig. 15; text fig. 8)

Body small, broadly acolidiform, up to 15 mm. in length. Branchial papillae comprising 4 rows of closely-set, claviform, non-caducous papillae set all round the dorsal margin, including across the tail. Rhinophores claviform, median part of rear edge set with 4 rows of closely-set papillae, as in *Madrella* Alder and Hancock, non-retractile. Median part of dorsum smooth; a large pericardium is centrally situated a little to the right posterior side. Genital orifice large, on the right anterior side, forward of the pericardium. Anus situated among the branchial papillae on the posterior edge of the dorsum, elevated slightly. Nephroproct(?) on right side, next to pericardium, arises from among inner rows of branchial papillae and faces forward. Foot pale pink, long, rounded and thickened in front and pointed behind, extending posteriorly beyond papillae; crest of tail bare. Head small, no noticeable veil as in other species, but the head-corners are produced slightly into short digitiform tentacles. Mouth typical of the genus. Body-colour reddish-fawn; median part of dorsum orange or red; pericardium vermillion, brighter than dorsum, outlined with yellow; rhinophore-sheaths joined by a yellow patch, which itself is joined to the yellow around the pericardium by a short but broad yellow line. Head pale pink, tail transparent; rhinophores clear, speckled with greenish-yellow spots.



Text fig. 8.
Proctonotus? affinis sp. nov.
A—dorsal view, a—genital orifice, b—nephroproct(?), c—anus, d—papillae, e—pericardium.
B—*detail of rhinophore.*

Branchial papillae fawn, externally speckled with minute red spots, so that they appear reddish, internally dark brown. Radula not examined.

Locality: Torquay (1 spec., Oct., 1956; 6 spec., Oct.-Dec., 1957).

Station: Rather common, under stones at and below mid-tide.

Remarks: At first this species was thought to belong to the genus *Madrella* Alder and Hancock (1864) because the rhinophores are of the same type as that genus. But the positions of the anus and nephroproct, and the shape of the branchial papillae, would not allow for the reception of the species there. The genus *Proctonotus* Alder and Hancock (1846) was originally stated to have the rhinophores linear, the papillae tuberculate, and the papillae not continuous over the posterior part of the dorsum. In

these points this species does not agree, and thus it is only tentatively referred to *Proctonotus* at present.

Unfortunately, as stated for the previous species, the author has been unable to ascertain the systematic position of the species. The dorsal anus is somewhat reminiscent of the doridiform nudibranchs, but otherwise seems quite unrelated to any of the 3 sub-orders, Arminacea, Dendronotacea, and Eolidacea.

DOTO OSTENTUS sp. nov.

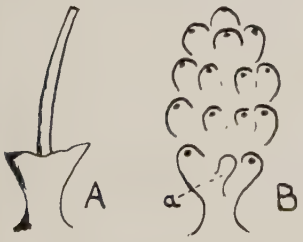
(Pl. 1, fig. 5; text fig. 9)

Body somewhat aeolidiform; small, slender, length 8 mm., breadth without cerata 1 mm. Head a little expanded into a semi-circular head-veil. Rhinophores simple; a long, slender, curved clavus arising from a large, cup-like sheath, the anterior of which is broadly crenulate. Dorso-lateral margins, with 7 pairs of large, non-caducous cerata, each pair being the same size except the last, which is much smaller. Cerata clavate, each ceras with 3-4 circlets of papillose nodules, 6-7 nodules in each circlet, nodules rounded. Branchial fold is in the form of a single horn-like projection on the inner side of each ceras. The anus, which protrudes considerably, is situated dorso-laterally between the first and second cerata on the right side. Body-colour white, everywhere except rhinophores and foot spotted with minute black dots; cerata pink, a black spot on the apex of each nodule and also the apex of each ceras.

Locality: Torquay (2 spec., Dec., 1957; type locality), Flinders (4 spec., May, 1958).

Station: Not rare, under stones in pools at mid-tide.

Remarks: This is the first record of the family Dotonidae from Australia. Rather similar to the type of the genus *Doto maculata* Montagu, but differs in a number of small features about the cerata and colouring.



Text fig. 9.
Doto ostentus sp. nov.
A—detail of rhinophore.
B—detail of single ceras, inner aspect,
a—branchial fold.

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EXPLANATION OF PLATES.

Plate 6.

1. *Elysia furvacauda sp. nov.*—dorso-lateral view.
2. *Palio parvula sp. nov.*—dorsal view.
3. *Palio parvula sp. nov.*—ventral view.
4. *Paliolla cooki* (Angas)—dorso-lateral view.
5. *Doto ostentus sp. nov.*—lateral view.
6. *Platydoris galbanus sp. nov.*—dorsal view.
7. *Platydoris galbanus sp. nov.*—head.

Plate 7.

8. *Lamellidoris maugeansis sp. nov.*—dorsal view.
9. *Lamellidoris maugeansis sp. nov.*—ventral view.
10. *Goniodoris meraculus sp. nov.*—dorsal view.
11. *Goniodoris meraculus sp. nov.*—ventral view.
12. *Rostanga hartleyi sp. nov.*—dorsal view.
13. *Rostanga hartleyi sp. nov.*—head.
14. *Alloiodoris nivosus sp. nov.*—dorsal view.
15. *Proctonotus? affinis sp. nov.*—dorsal view.

ADDENDA

The missing names from the systematic list at the beginning of this article should be as follows:—

Sub-order - - - - - Arminacea.
Super-family - - - Pachygnatha.
Family - - - - - - **JANOLIDAE.**
**Janolus hyalina* (Alder and Hancock).
**Proctonotus? affinis sp. nov.*

The author can see no reason for the use of the family name Antiopellidae as Odhner (1939) has used. *Antiopella* was proposed by Hoyle (1902) to replace *Antiopa* Alder and Hancock (1848), which was already in use. *Antiopa* was proposed to replace *Janus* Verany (1844) which itself was pre-occupied. In 1884 Bergh proposed *Janolus* for a species with huge jaws, a feature which probably is only a specific difference between *Antiopa spp.* and *Janolus spp.* Therefore, the author has used the family Janolidae in preference to Antiopellidae.

—Robert Burn.

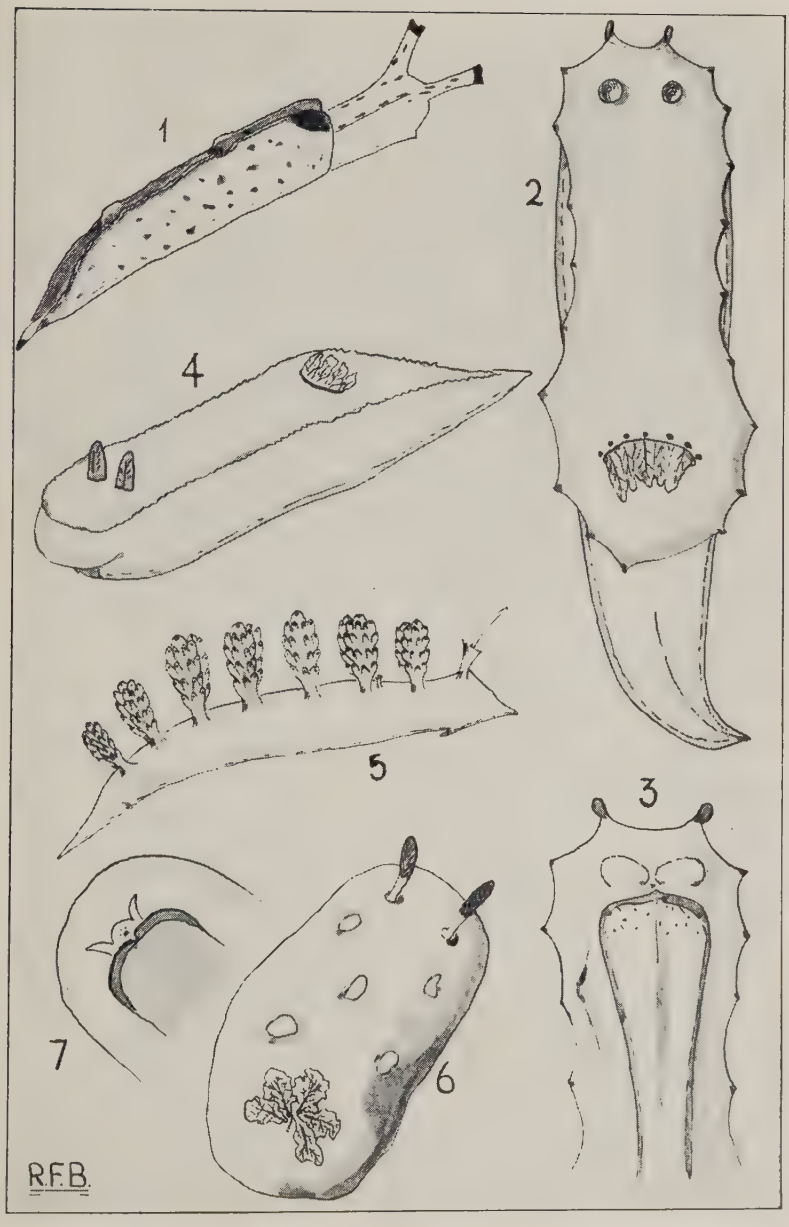

Plate 6.

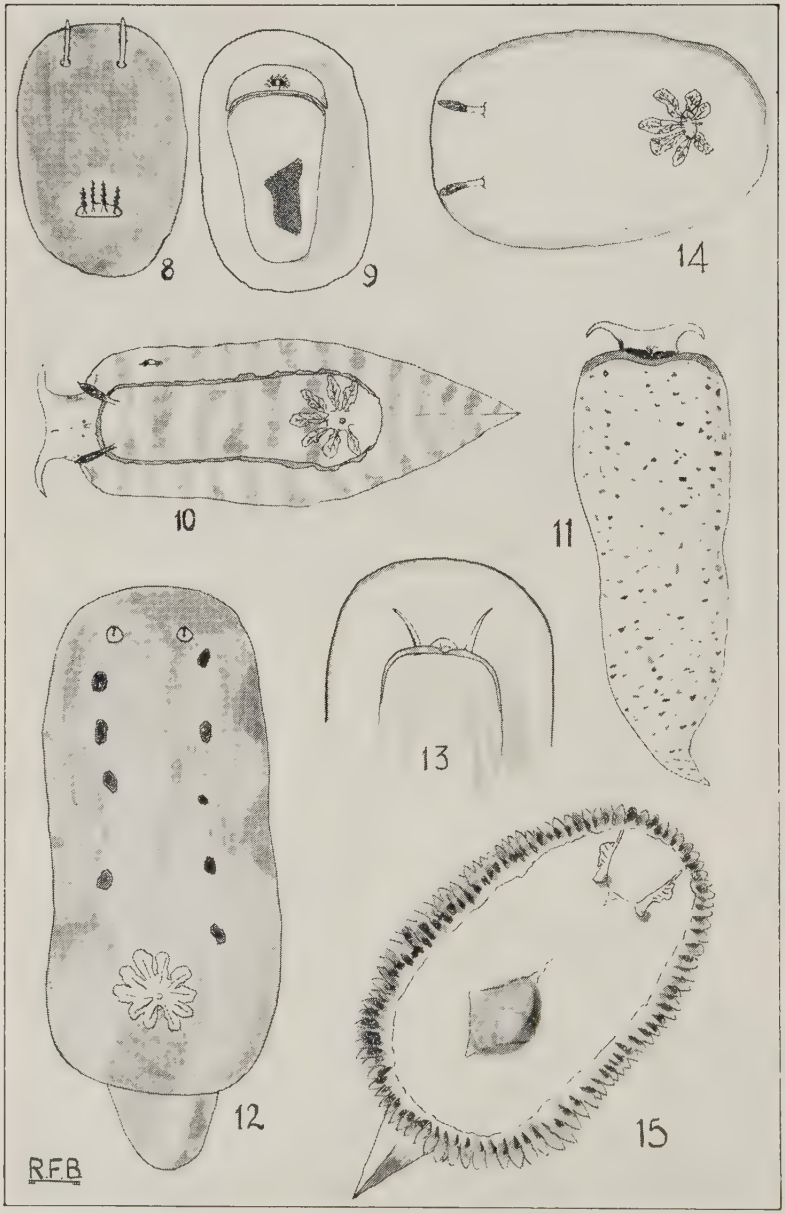

Plate 7.

MOVEMENT BY COMMENSAL *HIPPONIX CONICUS* (Schumacher)

by THELMA HARTLEY*

(Plate 8)

On 10th March, 1958, three dozen *Haliotis ruber* Leach were collected at Flinders, Victoria, Australia. On the majority of these shells the common Victorian limpet,† *Hipponix* (= *Sabia*) *conicus* (Schumacher) was attached. It is not unusual to find this limpet attached to a rock, dead shell, or the back of a live shell. However, it is unusual to find evidence of migration by this limpet. Fifteen of the *H. ruber* with *H. conicus* on them showed that this limpet had definitely changed position. Four specimens are used to illustrate this.

Figure 1.—In this specimen the trail of the *Hipponix* is on the marginal side of the tremata, and the limpet lies at the margin of the *Haliotis*. As with the other specimens, the limpet has its anterior margin at the anterior margin of the *Haliotis*. On the *Hipponix* is a young specimen 3 mm. wide.

Figure 2.—The trail left by the *Hipponix* begins half-way between the apex and the tremata; it extends to the latest formed trema, then follows the trematal line to the margin. At first the trail is only 2 mm. wide, and gradually widens until it is the width of the *Hipponix* shell (11 mm.). The trail is over 3 cm. long, and slightly recessed, the radial rugae and spiral striae being scarcely distinguishable thereon.

Figure 3.—The trail is smooth and gradually widens as in fig. 2. This trail is 8 cm. long, with an obscure beginning. The trail is of such age that there has been time for epiphytic plants and worm tubes to grow on it. The course of the trail is along the apical side of the tremata, i.e., it is spiral like the shell itself. The *Hipponix* shell is now at the margin, and measures 1.8 cm. in width.

Figure 4.—This is a large *Haliotis* (maximum diameter 10.8 cm.) with a trail having a maximum width of 2.3 cm.; it follows the apical side of the trematal line, and the older half is buried under epiphytes. The *Hipponix* has its anterior margin on the anterior margin of the *Haliotis*. On the anterior margin of the *Hipponix* is another *Hipponix* shell nearly 12 mm. wide, and with a clear trail 1 mm. long, the rest being less distinct. On this shell is a still smaller one only 4 mm. wide and situated at the anterior margin.

Comment: The trails are smooth because the *Hipponix* shells have interfered with the deposition by the periostracum. However, as the anterior margin of the *Hipponix* is curved, it is clear that some at least of the surface structures have been destroyed after deposition. In some places there appears to have been some secondary deposition.

The trails are tapering because the *Hipponix* has increased in diameter during its slow movement. The limpets are always at the anterior margin of the *Haliotis*, and so apparently always stay there. The rate of movement is therefore presumed to be the rate of growth of the shell margin.

The *Hipponix* shells, whether on older *Hipponix* or on *Haliotis* shells, are at the margin, and have their anterior margin to the anterior margin of the shell on which they rest. There must be some advantage for this to be the orientation preferred without exception. Supply of food and better oxygenation may be the reasons.

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† "Bonnet limpet" Allan, J. (1950) Aust. Shells, p. 86.

* Melbourne, Australia.

Plate 8.

A NOTE ON THE *MICROTIS* IN AUSTRALIA

By ROBERT TALMADGE*

(Plate 9)

The apparent scarcity of Australian records of specimens of the genus *Microtis* A. Adams, is the basis for this short note. Pilsbry, and others have placed this group, between the *Stomatia* and *Gena* in their systematic treatment of the family Stomatellidae. At the present time, too few specimens of shell, or shell and animal in combination, are available to the writer to do other than mention the finding of this genus in Australian waters.

A number of years ago, the writer received a sending of Haliotids from Mr. Tony Marsh, of Rockhampton, Queensland; which included a single example of *Microtis heckliana* Crosse. These had been collected in the Capricorn Group as a population series for a compartive project. The *Microtis* had been included due to the strong similarity to juveniles of certain Haliotids.

As little information appears to be in the records concerning this species, it is hoped that this note will stimulate interest, and that other collectors will watch for and preserve both shell and animals when found. No published records could be found for this genus in Australian waters. To assist, the following information is given:—

Microtis heckliana Crosse, *J. Conchyliol* 1871, Noumea, New Caledonia. The subcircular shell is extremely thin and fragile, with the spire almost completely depressed into the dorsal surface. The flatish dorsal surface is in contrast to the well-rounded ventral portion, meeting at an acute angle at the periphery of the whorl. Between the sharply incised suture and the periphery of the shell on the dorsal surface, there are a number of low rounded lamellae that radiate outward from the suture to a series of low rounded nodes. The interior of the shell is silvery nacerous. Due to these low nodes there is a superficial resemblance to juvenile Haliotids, with their closed forams. The coloration of the specimen examined was a dull green-white on the dorsal surface, with rusty maculations at the periphery. Ventrally the colour was light green and white in serrate wavy lines.

This does not match the colour or colour pattern as given by Pilsbry in his *Manual of Conchology*, Vol. XII.

However, one of the features noted in this family, Stomatellidae, has been the varied coloration and colour pattern within a species. Thus, it is probably possible to find specimens of various colours and with a number of combinations of patterns.

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* Willow Creek, California.

Plate 9.

Microtis heckliana Crosse, Capricorn Group, Queensland, Australia. Collected by Tony Marsh in 1955. Actual size: Major diameter, 16.50 mm.; minor diameter, 12.00 mm.; height, 5.00 mm.

A NEW TREE-SNAIL FROM NORTH QUEENSLAND

By DONALD F. McMICHAEL, Ph.D.*
Curator of Molluscs, Australian Museum, Sydney.

(1 Text figure)

The tree-snails of the subfamily Papuininae (family Papuinidae of Iredale 1938) are among the most conspicuous members of the land molluscan fauna of New Guinea, the islands of the Bismarck Archipelago and the Solomon Group. It is an interesting fact that comparatively few species of this group have reached Australia, despite the intermittent land connection between New Guinea and the Australian mainland which existed during Tertiary time. Iredale's Basic List of the Land Mollusca of Australia includes eleven species referred to the Papuininae, and another has been added since (*Meliobba shafferyi* Iredale 1940).

Among these is *Rhynchotrochus poiretianus* (Reeve) 1852, which is the type species of the subgenus *Noctepuna* Iredale 1933. There seems to be no good reason for continuing the association of *poiretiana* with the predominantly New Guinea genus *Rhynchotrochus*, so that *Noctepuna* is here used as a full genus. Clench (1943) recorded this species under the name *Papuina gartneriana* Pfeiffer 1851, regarding *poiretiana* as a synonym. However, the two are almost certainly distinct species, for the original description of *gartneriana* by Reeve (whose descriptions of both species antedates Pfeiffer's) mentions plicate striations and a purple-violet blotch on the umbilicus and columella margin of the lip, neither of which are found in *poiretiana*. The correct locality for *gartneriana* appears to be the Aru Islands as Tapparone Canefri (1883) suggested, for specimens in the Australian Museum from that locality agree exactly with Reeve's description.

Reeve gave the locality of both *gartneriana* and *poiretiana* as Port Essington, but Cox (1868, p. 67) showed that *poiretiana* was in fact collected at Night Island, off the north Queensland coast by Macgillivray during the voyage of the "Rattlesnake." The discovery of the species is recorded by Macgillivray 1852, p. 116.

When erecting *Noctepuna for poiretiana* Reeve, Iredale also included *Papuina nuensis* (sic) = *P. muensis* Hedley 1912. However, in his Basic List, Iredale (1938) listed the latter species under *Posorites* Iredale 1933, the type species of which is another Australian tree-snail, *Helix fucata* Pfeiffer. The latter generic placement of *muensis* is undoubtedly an error, for both *poiretiana* and *muensis* are subspecies of a polytypic species which occurs on the mainland on Cape York Peninsula. Specimens of the mainland race were recently forwarded to the Australian Museum by Mr. J. L. Wassell, of Silver Plains Station, near Coen, North Queensland, and as this is not yet named, it is described as new below.

Noctepuna poiretiana clenchi ssp. nov.

Shell trochiform, of 6½ whorls regularly increasing, the whorls slightly convex, the suture shallow. Body whorl rounded below, descending a little at the mouth, not constricted behind the aperture. Mouth oblique, oval, the peristome slightly expanded above, but not reflected; becoming reflected

* Sydney, Australia.

towards the outer edge of the lip and increasingly so below; towards the columellar, the lip expanded and reflected, almost covering the narrow umbilicus. A thin callus joining the margins of the aperture across the body whorl.

Protoconch of 1¼ whorls, not sculptured, but with an eggshell-like appearance under the microscope. Remainder of shell sculptured with fine radial growth lines.

Colour white, the body whorl marked with a dark brown band about 1 mm. in width, usually bordered below by a fine reddish-brown line; the band just below the level of the suture, not showing above the body whorl. Columella marked with a small brown spot.

Animal dark grey, the tentacles reddish-brown.

Type locality: Dinner Creek, at the foot of a spur of the McIlwrath Range, on the Coen to Port Stewart Road, North Queensland.

Types: The holotype is in the Australian Museum, Registered Number C.62421, and is figured on plate 10, figures 1-3. Paratypes are in the Australian Museum C.62422, and additional paratypes are in the Museum of Comparative Zoology, Cambridge, Mass.

Records: Clench (1943) recorded specimens of "*Papuina gartneriana* Pfeiffer" from Lankelly Creek, McIlwrath Range, which are probably this subspecies. Some specimens in the Australian Museum from Coen River are larger, but otherwise agree with *N. p. clenchi*. Mr. Wassell informs me that he has also taken the species at Merluna Station, about 100 miles north-west of Coen, and also from Port Stewart, Princess Charlotte Bay.

Habitat: The specimens were taken from branches of trees in thin marginal scrub along the banks of Dinner Creek, on the 16th July, 1958.

Dimensions (in mm.)

	Length	Maximum Diameter	Minimum Diameter
N. p. poiretiana			
Mean of 20 Topotypes	24.25	19.7	17.5
N. p. clenchi			
Holotype	19.0	16.5	14.0
Mean of 20 Paratypes	18.5	17.0	14.25
N. p. muensis			
Holotype	15.0	14.0	12.5
Mean of 4 Paratypes	13.0	12.25	12.0

Distinguishing Characters and Relationships: The new subspecies stands intermediate between the other two subspecies, *poiretiana* and *muensis*. *N. poiretiana poiretiana* Reeve is larger, and lacks the broad dark band of *clenchi*, in place of which it has a fine reddish-brown line only. The shell is normally cream coloured, not flat white as in *clenchi*. On the other hand, *N. p. muensis* Hedley is much smaller than either *poiretiana* or *clenchi* and is proportionately broader. *N. p. muensis* agrees with *clenchi* in possessing the dark, broad band, but differs in the general colour of the shell, which is light brown or buff.

N. p. clenchi appears to be rather widely distributed in the lower part of the Cape York Peninsula, and probably occurs throughout the Peninsula, as it has probably given rise to the *muensis* subspecies, which is known only from Mua or Banks Island in Torres Strait. It has probably also been the ancestral source of *N. p. poiretiana*, which is known only from Night Island.

The new subspecies is named in honour of Dr. William J. Clench, Curator of Molluscs at the Museum of Comparative Zoology, who with Dr. R. D. Turner is revising the Papuininae. Specimens of *N. p. clenchi* have been sent to the Museum of Comparative Zoology for anatomical study.

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Text fig.

Top left—ventral view of Holotype.
Top right—umbilical view of Holotype.
Bottom centre—left dorso-lateral view of shell and animal of Holotype.

CYMBIOLA SOPHIAE (Gray), FROM THE ARAFURA SEA.

By TAKASHI OKUTANI.*

(2 Text figures)

A single specimen of a beautiful Volute, *Cymbiola sophiae* (Gray) was brought back from the Arafura Sea by Mr. Takemura, biological investigator for the Tokai Regional Fisheries Research Laboratory during 1957, when he was in charge of pearl fishing. It was collected alive from the muddy bottom of the pearl fishing ground near Thursday Island at a depth *ca.* 25-35m. Though the present writer has examined several specimens of this species, collected from the Arafura Sea, before he was supplied with this specimen, it was his first opportunity to see the shell with animal. However, the visceral part was unfortunately lost.

CYMBIOLA (*VESPERTILIO*) *SOPHIAE* (Gray).

Voluta sophiae Gray, 1864, *Ann. Mag. Nat. Hist.*, xviii: 431 (*cit.* Tryon 1882, *Man. Conch.* IV.: 87).

Shell of medium size, elongate in shape, 6 cm. in height, stout; surface smooth, shiny; spire low, obtuse at the apex, encircled with spines with interspaces around the shoulder; spines short but acute, directed upwards, 10 in number on the body whorl, 6 on the penultimate whorl; protoconch followed by low spire bearing primitive and weak axial ribs, suture shallow, indistinct, not channeled, aperture narrow above, angular at the shoulder, broadly round below; outer lip simple, acute at the edge but somewhat thickened at the shoulder; columellar margin thickly calloused at base and provided with 5 strong and oblique folds; canal rather deeply sinuous dorsally; no operculum.

Coloration of the shell, light chestnut brown generally, with pale maculations here and there; body whorl girdled by two darker zones with brownish black spots of various size sparsely and irregularly arranged along the edges of darker zones; area between the suture and shoulder provided with axial brown striae; brown fine striae also around the columellar callous; aperture pinkish brown inside, gradually becoming darker towards marginal area of outer lip. Foot massive, broad in general; the dorsal surface rather rough, gray in colour with four transverse bands of yellowish gray and spotted with ashy white; epipodium smoothly round at the edge, slightly projected laterally, with fine delicate mammillar papillae along the marginal part; pedal sole smooth, broad, yellowish gray in colour with fine transverse lines; metapodium with blunt end. Cephalic tentacles rather short, obtuse at the tip, flattened, gray in colour. Siphon long, tube-like in shape, gaping along the ventral side, gray in colour with darker maculations; proboscis short in the fixed position. Mantle observable beneath the shell, yellowish white, but spotted with gray and yellow along the margin.

Remarks: Such workers as Tryon considered this species to be a form of *"Voluta" norrisi* Gray. And yet, this species is closely allied to *C. vespertilio* (L.) in every external feature. This species is distinguished from *C. vespertilio* by less elongate shape, more angular shoulder, more acute spines, lower spire, broader aperture and pale coloration or colour pattern. The shape of the foot of *C. vespertilio* figured by Tryon (1882, *Man. Conch.*

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IV, pl. 25, fig. 48; cited from Quoy, 1832, *Voy. Astrol.*, t. 14, fig. 3) is slightly different from that of this species in having a sinus of the lateral margin between the epipodium and mesopodium. But the present author is of the opinion that this may be rather exaggerated, as the epipodium usually projects laterally a little in such related Volutes as *Fulgoraria*, which has a bright reddish foot. Ecologically, this species seems to live buried in the muddy bottom, like other Volutes and their kin, *Melo*.

From the Arafura Sea, two other Volutes were also collected. They are *Volutoconus bednalli* (Brazier) and *Amoria turneri* (Griffith and Pidgeon). The former is extremely rare in the area, as only three specimens have been examined by the writer, while the latter is said to be rather commonly found in the pearl fishing grounds. This has been reported along with other shells from the Arafura Sea by Takemura and Okutani (1955, *Bull. Jap. Soc. Sci .Fish.*, 21 (2)), in which a part of the molluscan fauna in the "East" pearl fishing ground of the Arafura Sea was roughly summarized.

Text—figure 1.

Text—figure 2.
Cymbiola sophiae (Gray) collected from the Arafura Sea near Thursday Island.

ZOILA ROSSELLI Cotton

By THELMA HARTLEY*

(1 Text figure)

Zoila rosselli was originally described in 1948. In this article Mr. Cotton said the only specimens known were six taken by Mr. Rossell at Fremantle, Western Australia, with a possible seventh from Cottesloe, a beach just out of Perth and very near Fremantle. (According to information received by the author from various sources, there would appear to be twelve specimens in existence.)

Four of these shells belonged to Mr. W. R. Steadman, one of which was donated to the Adelaide Museum, which is the holotype specimen figured in five different positions. A broken specimen belonging to the series is also figured to show the interior structure.

In Mr. Cotton's *Remarks* he said: "The species is constant in character, size and shape. Only three distinct species and four sub-species of the primitive cold water cowries belonging to the genus *Zoila* are known, and they are found in Western and South Australia. There are four Tertiary species in the Miocene of Victoria, *Z. consorbrina* McCoy 1877, *Z. platypyga* McCoy 1887, *Z. simplicior* Schilder 1935, and *Z. toxorhyncha* Tate 1890. None of the Tertiary species resembles the recent one here described. Probably *Z. rosselli* is more closely allied to *Z. decipiens* Smith 1880, described from north-Western Australia than to any other species, but it is distinct."

Mr. Cotton points out the fact *Z. rosselli* differs in the flattened base with its spreading and sharply-edged margin and coarse spaced teeth of the columella and outer lip. Curiously, *Z. rosselli* has the general shape of *Siphocypraea mus* Linne 1758 Mediterranean, and of *Bernaya teulerei* Cazenavette 1846 Arabia, and *Bernaya fultoni* Sowerby 1903 Natal, but these three species have well-rounded bases and *Bernaya* is edentulous. *Syphocypraea* has a complete set of spaced teeth on the margins of the wide aperture, a feature which in some way recalls *Z. rosselli*.

Mr. Rossell took the shells from a beach near North Wharf just beyond the wall where all sorts of rubbish came ashore. The bucket dredges dumped their contents straight out to sea opposite this beach, which means the shells may have come from the bottom of the harbour.

Mr. Rossell wrote: "I remember small stones, some with shells such as *Turbo setosus* stuck in them in a partly fossilised state. . . . I often picked up immature *C. scotti* on this little beach, but of course *scotti* were, and some actually had the remains of the animals in. . . . If I remember, the time would be about October, after the equinoctial blows of September . . . it must be a long time since I took them, at least 30 years ago. I remember it very well, and the dorsum was pale brown, somewhat marked with tiny scratches and cleaned at once with the application of hydro-chloric acid. I imagined then that it effected an improvement in the shell's appearance, but I was just beginning to collect things and, had it been recently, I would have known better."

These shells, taken by Mr. Rossell over 40 years ago, have never been duplicated by any collector, and have changed hands only rarely. Although in Mr. Cotton's opinion, the specimens were dead when taken, and in spite of the fact acid was used on the dorsum, they remain beautiful specimens. The caramel-brown of the base, with darker brown spots showing through; the wavy left margin edge and the sharply humped dorsum all create an attractive effect. A truly outstanding shell.

* Melbourne, Australia.

At present these twelve shells are in the following collections. The South Australian Museum in Adelaide has the holotype; the National Museum of Victoria has, so I have been given to understand, one specimen; according to information received, the Cottesloe specimen is in the Australian Museum of Sydney; there is one *rosselli* in the private collection of Lt. Col. R. J. Griffiths of Melbourne (this is the broken specimen pictured below, showing the pearly white interior); two specimens collected at Leighton Beach by Mr. Rossell are in the Western Australian Museum, along with two specimens "presented by West, unknown locality and unknown collecting data, but may have been collected by Rossell"; one specimen is in the West Australian Naturalists' Club, collected by G. Kendrick at Leighton in 1955; one is in a private collection in the United States, having been sold recently by a Sydney shell dealer; and there are two *Z. rosselli* in the Hartley collection.

Text figure 1.

Zoila rosselli Cotton 1948

Fig. 1—*Zoila rosselli* ventral, holotpye.
Fig. 2—*Zoila rosselli* dorsal, holotype.
Fig. 3—*Zoila rosselli* anterior, holotype.
Fig. 4—*Zoila rosselli* posterior, holotype.
Fig. 5—*Zoila rosselli* dorsal aspect of broken specimen showing interior.
Fig. 6—*Zoila rosselli* lateral, holotype.

SOME SPECIES OF LAMELLARIIDAE (Class Gastropoda) FROM THE EASTERN AUSTRALIAN COAST

By JOYCE ALLAN.*

(Plates 10-12)

In presenting this paper I have purposely refrained from specifically identifying the species, but have confined myself to producing the illustrations coupled to a somewhat full description which should make them recognisable if encountered at any time. My reason for doing this was that some years ago it was my intention to revise the family Lamellariidae, and I prepared intensive descriptions and illustrations of living specimens when they were brought to me. These, however, appeared very rarely, and years went by without further material being collected by myself or friends. The outbreak of World War II, with its depletion of staff and the application to duties of more immediate concern necessitated the dropping of this revision temporarily. The post-war period was even more difficult with lack of staff and rebuilding of the Molluscan room in the Museum and other reasons, so that it only now that I have been able to do further work on this proposed revision. By publishing the species, unnamed specifically, except initially A, B, C, D, they may be of more use to an author who may be revising the group, more so than if I had suggested new names for one or two of them, only to have them possibly found to be no synonomous with other species, for it is my belief at this stage that they should be considered in relationship to species from beyond Australia just as closely as from various localities in Australia.

From New South Wales we have *Marseniopsis inominatus* Iredale 1936, type locality, Sydney Harbour, which Iredale named for Hedley's *M. sp. Lamellaria indica* Angas 1867—Hedley's *Check-list* No. 705, but this does not agree with the four species under discussion. *M. australis* Basedow 1905, is recorded from S. Australia; *Lamellaria ophione* Gray, 1849 (1850) is the only record for Victoria, Tasmania and Queensland. This species is also recorded from Auckland (Type), and S. Australia. Their revision needs critical study of literature and material, even for the genus *Lamellaria* Montagu into which I am placing them, perhaps tentatively, as they appear to have the characteristics of that genus more than others of the family.

The specimens did not stand up to continuous handling, and in the case of one was only semi-alive when first found and already decomposing while being described and illustrated, but nevertheless, the descriptions and illustrations were faithfully done on the living animal.

Superfamily LAMELLARIACEA
Family LAMELLARIIDAE
Genus *Lamellaria* Montagu 1815.

Soft animals somewhat pleurobranch-shaped, carrying a small, thin, whitish and shiny shell internally on the dorsal surface. Surface of animal may be gelatinous, more so in some species than in others, usually pustulose and often with light coloured retractile filaments, at times branched, scattered over it. Foot is usually shorter than mantle, although in some circumstances can extend beyond it posteriorly. Head and foot well formed. The genus

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is mainly known by the few small shells which are only occasionally washed ashore, the animal rarely, if ever seen. The animals are thought to be carnivorous, sexes separate. Type of genus *L. perspicua* Linne.

The animals vary from less than an inch to about two inches or slightly more in size; their shells from below, to approximately an inch, or a little more.

Lamellaria sp. A.

(Plate 10, figures 1-16)

Animal large, almost as broad as long, in some positions quite circular. Very active, gelatinous, especially the undersurface. Mantle has pustulose appearance with fine veining, and two humps on central dorsum with rows of retractile, often branching filaments radiating from them. Some pustulose formation on anterior opening of mantle which turns back. Shell is wholly internal, swollen, white, of shelly texture, with distinct radiating lines. It rests over the viscera, occupying the whole of the central dorsal surface.

On the undersurface, between the mantle and the foot, extends anteriorly the head with conspicuous long eye-bearing tentacles; the eyes are black, situated about 4 mm. from where the tentacles arise from each side of the head. Tentacles and eyes are wide apart and the head neck is fairly long. Mouth is a transverse slit, but a proboscis is exerted when the specimen is placed in spirit, showing a portion of red-brown jaw. The animal was a male and the penis was situated about 7 mm. from the base of right tentacle, non-retractile but curls into branchial cavity when quiesant; flattened, and broad terminally. Two gills are seen on the roof of the cavity; they can protrude somewhat through the branchial opening on the right side below the head.

The foot is about half as broad as animal, with a long, broadened tail, and anteriorly has a double furrow. On the upper anterior portion of the foot, on either side of the head neck, a lower lamina is formed into a rounded flap, and an upper lamina forms two similar but shorter overlying flaps. These do not protrude beyond the foot at all, but seem to lie on it (see Pl. 10, f. 15) attached by a small muscular portion to the foot furrow ends beneath them.

Internally the jaw has a horny, yellow-brown portion like a fish scale, with fine and strong transverse lines; the jaw is a uniform mass with no indication of rods or serrations that I could see. The radula is ribbon-like, part straight, part curled; pale horny. There are 24 rows of teeth, three teeth in a row 1.1.1., consisting of a medium tooth conspicuously toothed laterally, overlapped on either side by a strong lateral tooth.

Colour of the living animal is somewhat similar to that of the sea-hare *Dolabrifera brazieri*, a greenish-brown base, brown speckling between, and with large yellow-orange blotches scattered over the surface. The two humps, also on the dorsal surface are orange red, and the filaments are yellow. Tentacles are yellow speckled, gill creamy, orange-red tipped. Undersurface is creamy yellow with orange tinted edges and white speckling. The foot is pinkish yellow with white splashing and edges with orange tones and orange-brown spots anteriorly. In spirit the animal became grey with the pustules showing at intervals.

Measurements of animal. Animal was 3 inches long and approximately the same width. Shell measured 27 mm x 14 mm. Radula, 15 mm., one-third curled. Jaws, 3 mm x 2.5 mm.

Locality: Gunnamatta Bay, Port Hacking, south of Sydney, N.S.W. Collected M. Ward, January, 1941. Single specimen.

Remarks: When alive, this animal is extremely active, swimming by mantle movement, moving freely and turning over by curling over its foot-anterior to posterior; it also clings by its foot and swings around on an axis until the creature looks like a mushroom on a stalk, but very active indeed, and an extremely attractive marine animal (see Allan, J., *Australian Shells*, 1950, p. 138, fig. 1).

Lamellaria sp. B.

(Plate 11, figures 1-14)

Animal small, almost circular, of humped appearance which did not alter to any extent in preservative. Dorsal surface pustulose almost to warty appearance in spirit, which also made the animal seem solid and tough, rather more so than the living animal. The filaments characteristic of the former species did not show on this species. There was a square cut opening at the anterior end of the mantle, the base of this forms a siphon. Beyond this opening could be seen the long, linear tentacles protruding. The tentacles are interesting. Situated between the foot and mantle as usual, with the eyes half-way along their outer edge, an important difference lies between the position of the eyes in the species from Gunnamatta Bay (previous species), which are well below the base of the tentacles, which in themselves are wide apart and in almost straight line, whereas the Long Reef tentacles form a V at their base, with the eyes half-way down on projecting prominences on their outer edges.

The undersurface has a deep cut furrow leading to the branchial opening, through which the gills (two) protrude: they appear more free and much stronger than in the previous species. They are attached at one side to a cavity, and one of them is attached to the roof of the branchial cavity. The penis is flattened, broad, and of more uniform shape than with the former species. Strong lines cross from inner to outer edge, like corrugations. It protruded from a terminus but did not appear retractile. The foot has a very striking appearance. It is about one-third the width of the animal, broad anteriorly, pointed posteriorly, somewhat leaf-shaped. The foot-sole has a slightly pustulose appearance, which may be due to wrinkling. The anterior end prolongs into two short ears, deeply furrowed, the furrows running down into the ear tips. Upper and lower laminae of anterior end of foot united at each end wing, forming simple furrow. Jaw has fine transverse lines and under very high power fine radiating lines noticed here and there; edges thickened. Radula is ribbon-like, longer than that in the previous species. Twenty rows of teeth are free, the remainder are curled or weak, and formula of teeth I.I.I. Teeth are very strong, larger and stronger than those of previous species, neither were there any serrations on the teeth, whereas in the other species, the teeth serrations stood out conspicuously and the teeth themselves were delicate and smaller.

Colour, reddish-orange, which changed in preservative to creamy pink, with scattered black dots and splashes. Undersurface, foot, tentacles and penis light coloured; gills cream. Jaw light olive green; radula dark horn.

Shell, more globose and shelly than the previous one, and rounded. Horn coloured on upper part of the columella; fine radiating growth lines

with faint suggestion of fine transverse lines. The shell was heavier than the former, with a more elevated spire.

Measurements: Complete animal, 42 mm. in length (and possibly in breadth), 23 mm. in height. Shell: 22 mm. by 17 mm., spire 7 mm. across. Penis was 11 mm. long and 4 mm. wide. Jaw: 4 mm. long, 2 mm. wide. Radula: 15 mm. long, made up of 6 mm. action piece, 6 mm. free straight portion, the remainder was coiled, the radula being 1-2 mm. wide.

Locality: Long Reef, north of Sydney, N.S.W. Collected by M. Ward, 1940, at dead low water.

Remarks: During the very short time this was alive, before it was placed in preservative, it did not display the gymnastic actions of the former species. This species could prove later to belong to a different genus than the previous species. Their differences have a subgeneric ranking, at least, if not generic.

I have seen this species from Bottle and Glass, Sydney Harbour, and one very like it, if not it, from 20-30 fms. off Brush Island, South Coast of N.S.W.

Lamellaria sp. C.
(Plate 12, figures 1-10)

Animal elevated especially in the central dorsum; crawls by pulling itself along in jerks, and when resting looks very like a nudibranch. It did not at any time show tendency to swim, or elevate the mantle as some species do. Foot sometimes extends beyond the mantle posteriorly; it clings by flattening the anterior portion of the foot sole and head to a rock and raising the hind portion of its body right up. Foot curls narrowly when handled. The mantle opens at the anterior end, showing a siphonal groove. The latter is not deep cut as in the previous species, but shallow and wide. The mantle opening referred to above is more V-shaped than squarish. The head tentacles are long and narrow and extend well beyond the mantle anteriorly when crawling. The general texture of the body is inclined to be rather firm and tough, the dorsal surface covered with filamentous pustules, and in the dorsal centre, the most elevated part of the animal, there are a few larger humps forming a more or less ridge. The foot is much narrower than the mantle. The upper end of the foot sole has a gland which acts as a pedal gland and is used to assist its jerky locomotion. Anteriorly, the foot is deeply grooved and at the sides slightly winged. Eyes are below the base of tentacles, on the outer edge.

A female specimen only was collected. Its genital opening was located at lower edge of branchial cavity. There were two dark gills in cavity, one of which seemed double, and the larger single one appeared more free. The mouth showed a delicate, pale, glassy jaw at its entrance, which when examined showed longitudinal lines and fine cross lines. The radula was the usual type, with 18-24 rows of pale teeth, dentition formula I.I.I. meeting to a point in centre, the lateral on either side more or less hiding the median tooth. Shell white, somewhat calcareous, somewhat like the Gunnamatta Bay one. Size, 11 mm. by 13 mm. The illustration in Plate 12 shows its features well.

Colour of the animal is dark greenish grey, with black speckling and spots. The filaments on the dorsal pustules are yellow, making the pustules appear yellow. Foot pale yellow spotted and speckled with darker colour. Undersurface of the mantle is light greyish, with darker grey mottlings, with small subdued black marks in them. Scattered filaments very faintly show through. Head and tentacles bases are speckled dark grey. Jaws are pale horn colour; radula has pale yellow teeth; the ovary is yellow, and the gills very dark, as stated above. In spirit, the general tone became greyish green with darker spots and speckling. The disappearance of most of the yellow colour was due possibly to the shrinkage down of the yellow filaments which are exerted in the living animal. The surface pustules appear small and pointed.

Measurements: Animal, when crawling, 1½ inches long, ¾ inch wide. Shell, as stated above, is 11 mm. by 13 mm.

Locality: Angourie Pool, Clarence River, N.S.W. Found under big rock in deep water. Collected by A. A. Cameron and J. Allan, 6/6/1941.

Lamellaria sp. D.

(Plate 12, figures 11-20)

Animal small, rounded, mantle extended almost twice as far beyond tail tip as it does beyond head; mantle edges very thin, anterior opening in it appears almost like a crenulation, groove shallow. Surface is slightly pustulose. Undersurface shows a squarish head with slight but linear tentacles and eyes well apart at base of tentacles. The lower edge of the anterior foot groove extends beyond sides of foot in short flaps. Gills were not protruding beyond cavity. Jaws are horny and typical. Radula glassy, whitish, 19 rows in use, remainder coiled (slightly longer portion straight, detition formula I.I.I. typical in shape, with faint suggestion of serration on each tooth.

Shell shiny, whitish, calcareous over yellowish spire apex, elongate, spire small but elevated, longitudinal and somewhat wavy lines, with a few spaced transverse ones, especially towards the suture of the body whorl. Both male and female specimens were collected and examined. The specimen from Woody Head was a male and slightly smaller than the female from Angourie Pool. The male shell was small and a perfect little shape, with small spire, and, although most of the calcareous element was patchy, yet the shell remained glassy, firm and opalescent. Female shell was naturally slightly bigger.

The penis of the male specimen was not protruding; it was tucked into the branchial cavity and formed an arched shield, as it were.

Colour: General colour of specimens was light salmon pink with tendency to orange. Specimens seemed immature, and colour of the smaller tended to cream with orange tints and speckled with orange-brown; orange spots appear on dorsal surface, and round the mantle undersurface. Gills were cream, and tentacles cream speckled with orange.

Measurements: Male animal (Woody Head) was only ½ inch long, shell 6 mm. x 4 mm. x 4 mm.; the Angourie specimen, a female, was one inch long, with a corresponding larger shell, 10 mm. x 7 mm. x 9 mm. Tentacles were 3 mm. long and jaw 2 mm. x 2 mm.

Locality: Woody Head (male) and Angourie Pool (female), Clarence River, N.S.W. Collected at low tide, clinging to rock, by A. A. Cameron and J. Allan, June-July, 1941.

Remarks: A female specimen was also collected on sponge at Kirra Beach, Coolangatta, Queensland, and also another male, ¾ inch long. None of the specimens preserved well, and they became very shrunken and colourless, but the rather lengthy descriptions and the illustrations should identify specimens of their kind when found. It is quite possible all the specimens were partly undeveloped, but it is not expected their length would exceed very much more than that of the female mentioned earlier.

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EXPLANATION OF PLATES.

Plate 10.

Fig. 1. Dorsal view of *Lamellaria sp.* A from Gunnamatta Bay.

Fig. 2. Dorsal view with mantle cut to expose internal shell in situ.

Fig. 3. Anterior portion of undersurface to show mantle with siphonal groove, head with tentacles, mouth, grooved foot and penis protruding at left of neck.

Figs. 4, 5, 6. Three views of gymnastic manoeuvres of animal witnessed before being preserved. Note the free swinging of mantle in relation to foot.

Fig. 7. Jaw of species A.

Figs. 8, 9. Two views of shell after removal from dorsal surface of animal.

Fig. 10. Radula of same species. A number of rows, each composed of three teeth. (Much magnified.)

Fig. 11. A single row of radula teeth consisting of a median tooth flanked on either side by a single lateral tooth.

Fig. 12. Two lateral teeth.

Fig. 13. Median tooth from radula.

Fig. 14. Penis.

Fig. 15. Anterior part of mantle turned back to display head with eye-bearing tentacles, (a) foot flaps, (b) branchial cavity, (c) penis, and (d) siphonal groove.

Fig. 16. Anterior mantle cut and turned back to show (a) mouth with jaw within, (b) bulbus pharyngeus, and (c) radula.

Plate 11.

Fig. 1. Dorsal view of animal *Lamellaria sp.* B., from Long Reef, N.S.W.
Fig. 2. Mantle cut to expose internal shell in situ.
Fig. 3. Undersurface of species showing eye-bearing tentacles, penis on left side between mantle and head, and complete foot with anterior groove terminating in side wings.
Fig. 4. Side view showing normal elevation of animal.
Figs. 5, 6, 7. Views of complete shell, and internal and external view of spire (all magnified).
Fig. 8. Penis of *Lamellaria sp.* B. (magnified).
Fig. 9. Complete radula (magnified).
Fig. 10. Median tooth from radula.
Figs. 11, 12, 13. Lateral teeth from radula.
Fig. 14. Jaw removed from animal, *Lamellaria sp.* B.

Pate 12.

Fig. 1. Side view of *Lamellaria sp.* C., from Angourie, Clarence River, N.S.W.
Fig. 2. Dorsal mantle of same cut to expose shell in situ.
Fig. 3. Head showing eye-bearing tentacles.
Fig. 4. Undersurface of anterior end of mantle showing dark depression which apparently serves as siphonal groove.
Fig. 5. Undersurface of mantle to show branchial cavity in relation to head and upper end of foot.
Figs. 6, 7. Two views of complete shell.
Fig. 8. Jaw of *Lamellaria sp.* C.
Fig. 9. Median tooth from radula.
Fig. 10. Selection of lateral teeth from various rows of radula.
Fig. 11. *Lamellaria sp.* D., from Angourie and Woody Head, Clarence River, N.S.W. (male).
Fig. 12. Anterior view beneath mantle showing head with tentacles, and below the head the front view of foot showing the lateral groove.
Fig. 13. Penis of male.
Figs. 14, 15. Shell of male animal.
Figs. 16, 17. Shell of female (shells and sectional drawings all magnified).
Fig. 18. Jaw.
Fig. 19. Median tooth from radula of female.
Fig. 20. Some laterals from same.

Plate 10.

(Plate II)

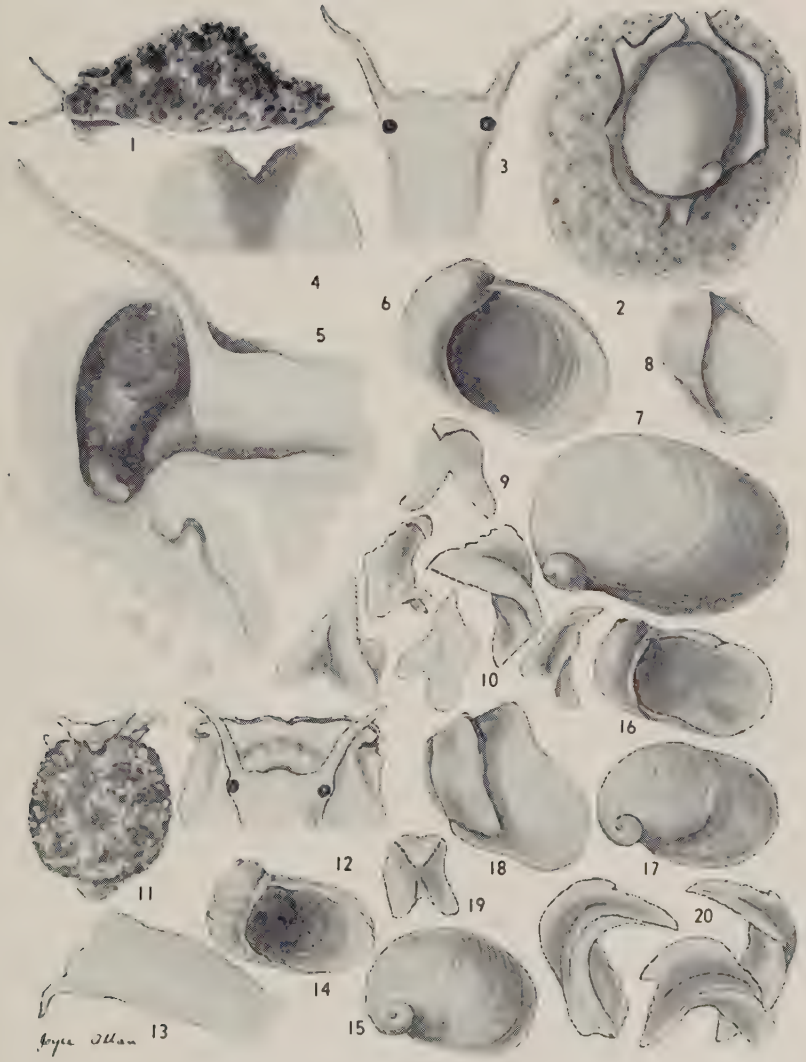

Plate 12.

TASMANIAN INTERTIDAL MOLLUSCA

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Text figures 1-2.

Abstract.

Study of the Tasmanian mollusca reveals several aspects of species constitution, of affinity, and ecology, which seem to support the conclusions of other workers dealing with general ecology and with relationships. Thus the mollusca are part of an ecological unit, the basis of which is ecological rather than faunal, with affinities for areas of similar latitude probably discernible. The mollusca are also, in general, part of a southern Australian faunal entity extending to New South Wales and southern Western Australia, yet with individuality, and even a little Neozelanic affinity. Available evidence suggests, however, that the Tasmanian fauna is, for the most part, disinct from that of tropical Australia.

Introduction.

In this work the mollusca are studied as a separate entity of shore life, but without divorcing it from other shore life, as has been the approach of students of the Tasmanian mollusca in the past. This approach has been influenced, and materially aided, by the studies of general ecology carried out in recent years. Thus it has become evident (as has been long suspected) that some bio-geographical individuality exists in Tasmanian environments. This may even extend to the Victorian coast, where there are many faunal affinities, as well as some distinction. In reverse there are hints of the presence of South Australian and New South Wales influence. The relative position of the Victorian exposed coast fauna has been made clear by Bennett and Pope (1953), who are inclined to include this area with Tasmania in a cool, temperate "Region." Guiler (1954*b*) is in general agreement with this postulation. Guiler (1950) reviewed most of the literature having a bearing on the ecology, to which reference will be made herein. Accordingly, only a few remarks will be made relating to certain literature having a specific bearing on the present subject.

W. L. May studied the Tasmanian mollusca over many years, and his work is summarised in his "Index" (1923). Iredale and May (1916) proposed to designate the east coast of Tasmania the Maugean Region, and Bennett and Pope appear to favour the extension of this term to cover all of Tasmania and the exposed Victorian coast as above indicated. The north coast of Tasmania, according to Iredale and May, is pure Adelaidean (since renamed "Flindersian" by B. C. Cotton). Some agreement with this idea is possible, but an overall study inclines one to the view that the fauna is Tasmanian. It is also (if one likes) part of a Bass Strait fauna, with affinities with its surroundings which are less marked to the east. Essentially the differences between North Coast faunas and those of other parts of Tasmania are due to ecological factors, such as differences of exposure, and so on. From a broader viewpoint, this was recognised by Bennet and Pope (1953), but that there is a Flindersian influence was

* West Tamar, Tasmania.

recognised by Hedley (1904). Hedley's basic idea has been partly confused because some of his evidence was ecological, and because nomenclatorial revision has altered other aspects. He does not seem to have envisaged the full extent of the probable Bass Strait land area, but to have realised all its vicissitudes would have been a remarkable achievement even for an author of his calibre. Without going into details, it may be considered that the land bridge did actually exist. There has always been the danger of calling into existence such a factor to account for a fauna which is itself then used as proof of that factor. In this case geological evidence is gradually forthcoming to support the hypothesis. Assuming the land bridge, Hedley's division of the fauna must have occurred, but because of migrations of the fauna and the length of time since the land vanished, intermingling has occurred and a balance achieved. Iredale, Laseron and others have shown that some factor (i.e., migration) has been in force in the past to bring Tasmanian faunal influences off the New South Wales coast and the reverse in regard to the Tasmanian coast. Smith and Iredale (1924) found evidence of a probable Pleistocene strandline on the continental shelf off the coast of New South Wales. Associated was a fauna directly comparable with modern Tasmanian molluscs.

The eastern fauna did actually come into the Bass Strait area, but it is less obvious. The influx of the sea on to the Bass Strait land surface probably may be definitely regarded as being principally of western waters at first, and it is not surprising to find some western influences on north-eastern Tasmanian shores. If a western migration into Bass Strait was the initial one, it is natural to assume that its influence would in the end predominate. But it must be realised that this fauna (i.e., that now found in Bass Strait with some modification) may simply have been returning to a formerly held "home." No doubt, by the process of adaptation formerly outside forms came here and were able to survive. In addition, the fauna has now tended to assume a character of its own. Probably we may summarise the present position by asserting that the obvious Tasmanian elements tend to be found in the most exposed areas, while northern elements seek more shelter. Something further will be said of this later. This type of occurrence is commonly found elsewhere; for example, Peronian elements appear in Victorian bay faunas. The greatest influence in the long run on the shore fauna must be an ecological one, for the effect of change on metabolism is apt to be profound, and it seems a long recognised factor that it is easier for a shore animal to migrate north rather than south.

Another vexed question is that of the traces of New Zealand elements in the Tasmanian mollusca fauna. No evidence of direct communication between the two countries is forthcoming. There is the possibility that ocean currents were or are responsible. Or that a northward migration during a Pleistocene "shallow sea" met and mingled with a New Zealand migration in part, subsequently returning south to new shores. These possibilities are far from satisfactory, and do not take into account the land and freshwater faunal resemblances, although these could have branched from a "southern origin." No single factor will explain the difficulties of such affinities, and any evidence is certainly clouded by past migrations and present ecology.

The immediate problem then is the full interpretation of the ecology of the shore faunas. Thus students of the mollusca not taking all the evidence into account are apt to be led astray. Ashby (1926) proposed to alter Hedley's zoo-geographical regions on the basis of his chiton studies which were not sufficient alone, but he did realise individuality in the Tasmanian fauna.

The present work does not pretend to provide answers to the many problems involved, but is merely a study of the Tasmanian intertidal mollusca found on the various types of shoreline, together with some of the affinities with other parts of the Australian coast. The work is based on notes made during tours of the southern, eastern, northern, and western coasts, from the Derwent River Estuary to Marawah. The writer has also had the benefit of studying mollusca collected by Dr. Eric Guiler in southern Tasmania and from Trial Harbour on the west coast. Other references, duly acknowledged, are drawn from the literature. The writer is grateful to Dr. Guiler for his continued interest in the writer's work.

THE ENVIRONMENT

Tides.

Guiler (1950) described the greatest rise of tide in the Derwent Estuary (south Tasmania) as of the order of three feet six inches and the greatest fall of the order of five feet. On the north coast the maximum tidal range is of the order of nine to ten feet. The east coast and the west coast of Tasmania are comparable with the southern coast in the matter of tidal range. The essential difference lies in the fact of wave exposure on the oceanic coasts, where wave action and spray may extend the "intertidal" habitat very much beyond a presumed normal on which nomenclature is based.

Geology.

The general geology of Tasmania has been described by Nye and Blake (1938), who make general references to the coastline. The following remarks are based largely on the writer's own observations, substantiated by numerous references to the available literature. Much of the rocky shoreline of Tasmania consists of the highly resistant dolerite. In some places, principally in the north, more recent extrusive lavas are present. Ancient resistant metamorphosed sediments form headlands in certain places, while massive granites appear in others. Thus a great deal of the rocky shore is highly resistant to wave action and the environment is apt to be jagged and boulder strewn, with little in the nature of platform surfaces. In certain areas Peruvian mudstones and fillites outcrop on the shore, and in such places erosion has been more extensive, with the formation of platforms, caves and blowholes. Bays are frequently cut in soft Triassic sandstones, and there are stretches of emergent coast with sandy beaches backed by dunes, behind which lagoons are impounded—notably on the East coast. Flandrian drowning has contributed to the formation of estuaries, while emergence has provided mud flat and salt marsh in certain bays and lagoons.

Text figure 1:

Locality map and Isohyets.

Climate.

On the basis of Thornthwaite's system (Gentilli 1948), the climate of Tasmania may be summarised as follows. There is a sub-humid warm climate in the north, east, and midlands. There is a sub-humid cool climate in the south-east and central eastern midlands. There is a super-humid cool climate in the west, with a small area of cold climate on the Central Plateau. A map (Text fig. 1) has been prepared from information provided by the Weather Bureau, Hobart, showing the isohyets of rainfall which relate particularly to coastal climate. Certain inland centres of high and low rainfall are also included to make the above summary clear. The western high rainfall materially affects estuaries, and even bay waters in that area, by reason of the volume of water in the rivers. This is not true on the east coast, but a large volume of fresh water may enter bays and estuaries during winter floods. The headwaters of the Derwent and Tamar are in high rainfall areas, but the length of these rivers modifies the effect on estuaries.

The extent of dessication due to exposure to the heat of the sun is greater in the east and north where there are more cloudless days than on the west coast. Tasmania is in the path of the Westerlies, with occasional Antarctic influences. Hence greater turbulence may be expected on western shores, but all exposed coasts except those in Bass Strait are subject to oceanic conditions with gale force winds. Nevertheless, storms of western or eastern origin may concentrate in Bass Strait and produce gales with considerable wave action, and this is a common winter occurrence. The centres of the principal low pressure systems appear to pass just to the south of Tasmania during the winter. Other systems may develop in the Bass Strait region or to the east, while occasional tropical systems reach far enough south to influence the north and east. Other factors involved include the topography of the island and the ocean currents. Thus the warm East Australian current no doubt assists other factors in producing a considerably milder climate in the north-east of the State. There is apparently some westerly drift into Bass Strait, which will ensure western influences along the north. But the eastern influences are very strong, and Dannevig (1915) envisaged a building up of the waters in central areas. Bennett and Pope (1953) found that there is some westerly predominence.

Table 1 shows the maximum, minimum and average mean temperatures, and the highest and lowest recorded temperatures for certain coastal stations in Tasmania.

Table 1—Temperatures at Coastal Stations.

	Temperatures in degrees fahrenheit.				
Locality	Maximum mean	Minimum mean	Highest recorded	Lowest recorded	Average mean
Burnie	59	38	85	30	48
Cape Bruni	57.9	47.3	99	28	52.6
Cape Sorell	58.7	49.2	90	30	53.9
Currie	61.1	49.8	96	30	55.4
Eddystone Point	61.7	49.6	96	30	55.7
Hobart	61.9	46.8	—	—	54.3
Hythe	59.8	44.1	—	—	41.9†

Kettering	59.3	42	—	—	50.6
Low Head	60.1	49.1	84.6	27	54.6
Maatsuyker Is.	56.7	47.1	94	31	51.9
Marawah*	58.4	46.1	—	—	52.3
St. Helens	63.9	44.4	103	20	54.1
Stanley	60.2	48.5	93	20	54.3
Swansea	63.2	45.6	104.1	24	54.4
Zeehan	59.1	43.5	99.2	19.4	51.3

† The low average mean record for Hythe probably is an error.

* Marawah is some miles inland from the West Coast.

Table 1 is based on figures kindly provided by the Weather Bureau at Hobart. Certain sea temperature records are given by Guiler (1950) and Kershaw (1957), while Bennett and Pope (1953) give a table of temperatures from readings by H.D.M.S. "Galathea" in "South-eastern Australian waters." The variability of rainfall in Tasmania is discussed by Scott (1956), who remarks the greater variability in the east which is significant in the final analysis of differences between east and west, and in the conditions experienced in the east and north-east.

Intertidal Classification.

There has been some controversy on the matter of classification of various parts of the shore. Hence the Tasmanian work of Guiler (1950, 1953) is followed for two reasons—firstly for the sake of uniformity, and secondly because the writer has found it in general sound in application. The zones recognised by Guiler are "the Supralittoral," "the Midlittoral" and "the Infralittoral." The Supralittoral and the Midlittoral are separated by a "Supralittoral Fringe," the highest area reached by spring tides. The Midlittoral zone is the normal tidal area. The Midlittoral and the Infralittoral are separated by the "Infralittoral Fringe," which is the region exposed only at extreme low spring tides. The flora and fauna of these areas have sufficiently distinctive features to enable their being recognised in the field. Guiler has recommended that for further subdivision of these zones, the term "Belts" be used, each belt to be distinguished by its characteristic plant or animal, in general the dominent species of that belt, or part of the shore. These "parts" of the shore are well recognised, but different terms have sometimes been used in defining them. The writer has no intention of discussing the matter and hereinafter the above scheme will be used. The nomenclature is also here applied to sandy shores as far as possible in order to avoid terms such as "midtide" which convey little without detailed knowledge of a particular shoreline.

A different mode of classification has been used by Guiler (1951) for a lagoon, based on the presence of a belt of the sea-grass *Zostera*. Thus there are three zones, the "Supra-*Zostera*," the "*Zostera*," and the "Infra *Zostera*." These are subdivided into "Belts." This has come in for some criticism, but the writer has found it useful in sheltered waters in northern Tasmanian localities, and it is here used where desirable. It is possible to correlate this scheme with rocky shore zones in some places.

Intertidal Belts.

1. *The Supralittoral and the Supralittoral Fringe.*

As pointed out by Guiler (1953) and Cribb (1954) a belt of yellow, orange and grey lichens is often conspicuous on Tasmanian coasts, notably where there is considerable spray. In the writer's opinion, this is as true of the north coast as the above authors found it true of southern and eastern coasts. The first molluscs to be encountered on the exposed shore are found immediately below this belt, in the Infralittoral Fringe. *Melaraphe unifasciata* (Gray) and *Melaraphe praetermissa* (May) here form a belt which is only absent when *M. unifasciata* cannot obtain a hold or the habitat is virtually absent. On the sandy ocean shore there is no equivalent mollusc, but in sheltered areas *Ophicardelus ornatus* (Ferussac) and *Bembicium auratum* (Quoy and Gaimmard) (*qv.* Cotton 1956 *b.*) may be present on rocky shores, and *Salinator solida* (Von Martens) on mud flats. *Ophicardelus* is only present in certain very sheltered localities. *Bembicium* commonly replaces *Melaraphe* as a belt forming species in sheltered areas, but is probably not found so high on the shore as the Infralittoral Fringe, and therefore is not strictly equivalent to *Melaraphe*. On the exposed shore *Bembicium nanum* (Lamarck) occurs throughout the Midlittoral where conditions are suitable, and does not compete with *Melaraphe*. *Melaraphe unifasciata* may occur on sheltered shores, but frequently is small and few in number of individuals. *M. praetermissa* appears to favour more moisture in the form of increased spray or tiny pools in which the writer has observed it to congregate. This latter species extends to Victoria, whereas *M. unifasciata* is present as far north as southern Queensland, (Endean, Kenny and Stephenson 1956).

2. *The Midlittoral.*

On the North Coast a *Melanerita* Belt is referred to by Kershaw (1957), in which *Melanerita melanotragus* (Smith) is in noticeable numbers associated with *Bembicium nanum* (Lamarck), *Austrocochlea constricta* (Lamarck) and *A. concamerata* (Wood), these latter species usually seeking shelter. *Melanerita* is only present on coasts with some degree of exposure; it is only common on the North Coast, but is present on the East Coast and the West Coast at least as far south as Trial Harbour. The northern occurence is more nearly equivalent to that of the mainland of Australia than other parts of Tasmania. On sheltered shores *Bembicium auratum* is the dominent species of this area, although on certain partly exposed shores in the bays or estuaries such as north of Kelso in the Tamar Estuary it is reduced to an associate of *Austrocochlea obtusa* (Dillwyn) in its smaller estuarine form.

The Barnacle Belt is next present on most rocky shores, though sometimes reduced by competition with mussels. Juvenile *Melaraphe* may be found in this area. *Bembicium, Austrocochlea spp.* and *Melanerita* are found over most of the shore. The barnacles may be succeeded or, as inferred above, almost replaced by Mussel Belts, as at Bridport, where *Modiolus pulex* (Lamarck) competes very strongly with the barnacles, or again, preceded as is often the case on the East Coast by *Austromytilus rostratus* (Dunker) (*olim Brachyodontes*, Laseron 1956). In the sheltered West Arm of the Tamar River the competition is reduced, as *Modiolus*

pulex tends to prefer rough surfaces, while the barnacles, *Elminius modestus* (Darwin), occupy smooth surfaces, but in any case the sheets are not continuous, probably due in part to influxes of muddy sand, or mud.

On the exposed Tasmanian coasts there is commonly present a Patelloid Belt occupied principally by *Cellana solida* (Blainville) and *Siphonaria app.* with other limpets. This belt is present at West Head on the North Coast, but the ocean coast belt is the more populous. *Cellana solida* occurs on semi-exposed coasts such as Oyster Bay and even in relatively sheltered bays such as Coles Bay at the head of Oyster Bay (East Coast), but not on sheltered estuarine shores. The sheltered shore has no Patelloid Belt as such, but the equivalent area tends to be dominated by *Siphonaria diemenensis* Quoy and Gaimard, but there are associates such as *Bembicium* and sometimes the pulmonate slug, *Onchidella patelloides* (Quoy and Gaimard), a species found in considerable numbers in the West Arm, Tamar River, but not apparently in the south. On other coasts, semi-sheltered but not estuarine, particularly in the south, *Mytilus planulatus* Lamarck forms an important belt, much as used to be observable at the head of Port Phillip Bay in Victoria.

On most types of coast there is present a *Galeolaria* Belt consisting of the tubes of the serpulid worm *Galeolaria caespitosa* Lamarck, which encrusts the rocks. The encrustation is sometimes as a thin veneer, as on the most exposed parts of West Head studied by the writer, or reaching a thickness of three or four inches or more in favoured sheltered places. *Galeolaria*, however, does not form a belt or is entirely absent in fully exposed localities in Tasmania, unlike New South Wales where it apparently favours surf. Guiler (1954) has drawn attention to this point. Hence this belt is only of significance as a shelter for molluscs on coasts having various degrees of shelter. Both Guiler (*loc. cit.*) and the writer have noticed that *Galeolaria* appears to have periods of heavy mortality, when whole clumps break off and the population is reduced to an insignificant unit from which slow recuperation follows. It is probable that the sheltering population of molluscs, worms, etc., also suffer as a result. These include *Montfortula spp.*, juvenile *Sypharochiton maugeanus* Iredale and May, *Kellia australis* (Lamarck), *Lepsithais vinosa* (Lamarck) (preying on the others), and sometimes *Onchidella patelloides* amongst many others. In this area with increase of exposure the limpet, *Patelloida alticostata* (Angas) is important, and if often encrusted with the tubes.

In the vicinity of *Galeolaria* there may be a belt of the necklace weed *Hormosira banksii* (Turn.) Decaisne which provides shelter for many gastropods including the limpet *Chiazacmea flammea* (Quoy and Gaimard) in one of its forms. *Bembicium*, *Austrocochlea* (*Fractamilla*) *concamerata* (Wood), *A.* (*Chlorodiloma*) *adelaidae* (Philippi) and lower down *A.* (*C.*) *odontis* (Wood) are the common species, and these may have associated the sea star, *Patiriella exigua* (Lamarck), etc. On the North Coast shores *Modiolus pulex* is often reduced to a modified belt of small individuals, closely packed over small areas with barnacles, *Chamaesipho columna* (Spengler) and *Tetraclita purpurascens* (Wood) in association.

The lowest Belt of the Midlittoral is that occupied by Coralline algae, which often form a turf on exposed shores. The mollusc population rapidly increases in variety and numbers, and many appear under stones,

including chitons, particularly *Ischnochiton elongatus* (Blainville) and *Ischnoradsia cvanida* (Sowerby), with *Poneroplax albida* (Blainville) or *P. costata* (Blainville) according to the degree of exposure. In Southern areas the New Zealand *Amaurochiton glaucus* (Gray) is slowly spreading, and is noticeable in many places. Common molluscs are *Austrocochlea, Cominella, Dicathais, Pleuroploca, Micrastraea aurea* (Jonas), *Notohaliotis ruber* (Leach), *Forelepas tasmaniae* (Sowerby), *Patellanax, Notoacmea* (higher on sheltered shores), *Subninella undulata* (Solander), and many others. The species have been omitted in several cases as some vary with exposure, which will be clear later in this work.

Adjacent to the rocky shore of the West Arm, but not on the soft muds or sands unless there is rock surface just underneath, a great deal of Midlittoral is occupied by *Velacumantus australis* (Quoy and Gaimard), (Family Cerithidae). This mollusc is also present in such sheltered places as Port Arthur (Cribb, 1954) and Pipe Clay Lagoon (Guiler, 1951 *a.*), but the writer has not seen anything equivalent to the development in the West Arm. The species is not present as high as the *Bembicium* Belt usually, and is also only a minor constituent of more exposed faunas. It is not present on exposed coasts. It is usually absent except in exceptional conditions on parts of the shore where a *Zostera* habitat is present.

The *Zostera* Belt appears to extend from a point in the Barnacle Belt to a point in the *Galeolaria* Belt apparently central. The upper limit appears to vary with local conditions, and the writer has noticed it almost reaching the *Bembicium* Belt. The associated fauna is largely bivalves but with certain important gastropods. Stones lying on the shore or adjacent rock surfaces have in some areas enabled some correlation to be made between belts on the *Zostera* type of shore and rocky shore belts, but these are not accurate, hence the ill-defined extent of the *Zostera* Belt proper, indicated above. There are two types of shore upon which *Zostera* may appear. These are the sandy or muddy-sandy lagoon (e.g., Pipe Clay Lagoon) or estuarine inlet (e.g., West Arm, Tamar River) enjoying maximum shelter, and the sheltered bay or sandy estuarine shore. The best example of the latter type with which the author is familiar is the sandy shore north of Kelso, and Kelso Bay a little south of Kelso, both localities being in the Tamar River and hence estaurine. The West Arm, Kelso Bay, and the sandy shore north of Kelso have increased exposure in each case, but many molluscs are common to each. The first essential difference lies in the numbers of individuals of certain species, and secondly some species which occur outside the river mouth find a place north of Kelso, but not in West Arm, while some are peculiar to West Arm and/or Kelso Bay, but do not reach the river mouth. Other shores where *Zostera* is of note spring to mind, but these serve as examples, while in D'Entrecasteau Channel *Zostera* passes below low tide and is of interest in relation to the proximity of the Scallop beds, but is outside the scope of this work.

In other parts of Australia a Zosteretum is formed by this plant, in which populations of molluscs and other animals find shelter. This is hardly the case in Tasmania, but the writer has found small areas sheltering numbers of animals which perhaps may be referred to as a modified form of Zosteretum.

As already noted, the Supralittoral Fringe on the mud flat is commonly occupied by *Salinator solida* (Von Martens) and this species will even occur where there is a fair admixture of sand, as on the sheltered shore below the township of Stanley, north Tasmania. But it appears absent on the sandy shore north of Kelso. If there are stones present, the Midlittoral may be commenced by *Bembicium* and *Austrocochlea* as at Kelso, or *Bembicium* and *Ophicardelus* as in parts of the West Arm, the latter shells being in the Supralittoral, or S.-L. Fringe, otherwise sand or mud dwellers are encountered.

Provided there is sufficiently firm substratum, *Bembicium* will find a place and may form a Belt. It has done so in Pipe Clay Lagoon (Guiler 1951) and this will be used as a starting point. The following Belt is that formed by *Eubittium lawleyanum* (Crosse), which is very extensive in Pipe Clay Lagoon, much reduced at Kelso and other parts of the Tamar, although the number of individuals to the square foot is much the same. The Belt in the West Arm is much reduced where it occurs. The substratum here is muddier and the shore steeper, so that the amount of the shore exposed is a function of the tidal range and not the shallow depth as at Pipe Clay.

Assiminea brazieri (Tenison-Woods) is a localized dominant in the areas under discussion and does not form a belt. The next Belt then is that formed by *Anapella pinguis* (Crosse and Fischer) in Pipe Clay Lagoon. In the West Arm this Belt is very narrow and often absent. It is succeeded by pockets of *Katelysia peroni* (Lamarck) in West Arm, this species being virtually as plentiful as *Anapella*. *Katelysia spp.* are recorded from Pipe Clay Lagoon by Guiler (*loc. cit.*) under the name "*Marcia.*" *Anapella pinguis* is more plentiful in Kelso Bay, but both this species and *Katelysia peroni* may only be described as present at Kelso-north. Here as in Pipe Clay *Katelysia scalarina* (Lamarck) is relatively common at this point.

Zostera nana now forms a Belt which is also the *Zostera* Zone of Guiler's Lagoon classification. In Pipe Clay the compact beds do not favour the burrowing bivalves, and this is true of the West Arm, but not so of the Kelso localities. *Mazoma deltoidalis* (Lamarck) and *Katelysia scalarina* (Lamarck) are both found burrowing in the beds, while in firm sand where *Zostera* is sparse at Kelso-north, *Austromytilus erosus* (Lamarck) is found anchored in the substratum by the byssus to firm objects. Guiler records *Austromytilus rostratus* (Dunker) from the *Zostera* of Pipe Clay, and he has found this species at Trial Harbour on the West Coast, and *A. erosus* in a sheltered area at Fisher Island at the same locality.

In the Tamar localities the dominent animal of the *Zostera* or part thereof is *Salinator fragilis* (Lamarck), but is only among those present in Pipe Clay. In West Arm it is plentiful throughout the *Zostera* and often in other places. In Kelso Bay *Austrocochlea obtusa* is co-dominant, while at Kelso-north *Salinator fragilis* is only dominent on the shoreward edge of the *Zostera* belt. Over the remainder of the Belt there is a varied population, including *Austrocochlea obtusa* and *A. constricta*, *Cominella lineolata* and *C. acutinodosa*, *Parcanassa pauperata* (Lamarck), *Assiminea brazieri*, and *Cacozeliana granarium* (Kiener). The crab *Paragrapsus quadridentatus* (Milne Edwards) is also present. In the West Arm there is *Paragrapsus grimardii* (Milne Edwards) and *Mictyris platycheles* Milne Edwards, as at Pipe Clay Lagoon.

In the Infra-*Zostera* Zone, *Katelysia corrugata* is recorded by Guiler as the first dominant for Pipe Clay. This species is not present in the northern localities, but *Katelysia scalarina* is present at this point, though not in numbers. At Kelso-north it is a much more robust shell than in other areas, and resembles more nearly the type of shell found on the mainland. At Kelso-north *Cacozeliana granarium* became very numerous on the edge of the *Zostera* bed, but close inspection revealed that many shells were dead.

Austrocochlea obtusa (Dillwyn) is then dominent in Pipe Clay to the Lagoon bottom. In West Arm this species is present at a similar level, as also at Kelso. In Kelso Bay it is uniform throughout the shore, while at Kelso-north it appears best developed in the *Zostera* Belt. In these estuarine waters there are two forms, the smaller of which is generally found on the higher parts of the shore. In West Arm a large, robust form lives at extreme low tide and only occasionally reaches higher parts of the shore and is never in numbers. In East Coast bays this robust form may be the only one present, and is larger still. A small form is present in Pipe Clay Lagoon.

In Kelso Bay the bivalve *Laternula creccina* (Reeve) may appear at extreme low tide, while in West Arm it is replaced by *Laternula tasmanica* (Reeve) and this is equivalent to *Laternula recta* (Reeve) of the Mainland.

The Sandy Beach.

The number of molluscs actually living on the sandy beach is small, and many are only "exposed" at extreme low tide, but are frequently washed in shore alive by heavy seas. The first species which become obvious live in the Midlittoral, in an area approximately equivalent to the Zostera Zone of more sheltered shores. In point of fact, one of these species, *Uber conicum*, is found alive on the *Zostera*, as for example at Kelso-north. Universal on sandy shores, and probably in general, dominent is the bivalve *Amphidesma augusta* (Reeve), so far as the north and east are concerned, but in Sandy Bay, and in the vicinity of Dunally in the south, *Amphidesma erycinaea* (Lamarck) appears to replace it so far as is known to the writer. Cotton and Godfrey (1938) observe that Flindersian examples are smaller than Peronian, and this applies in Tasmania, in that North Coast examples are smaller than those from East Coast localities. *Uber conicum* (Lamarck) is found in a similar position on most sandy shores examined by the writer, exposed and semi-exposed, but did not appear on the most exposed beach on the East Coast visited, a place near Scamander, but as a heavy sea was running accurate observations were difficult.

Living rather lower and apparently universal is the Venerid bivalve, *Placamen placidum* (Philippi). All localities visited on the north, east and south yielded examples alive. However, none were obtained at Marawah on the West Coast, but here again results were hampered by heavy seas, and few bivalves were obtained. *Katelysia scalarina* is generally found, and at Sandy Bay near Hobart is a robust shell associated with *K. corrugata*. In the north *K. peroni* appears, but does not appear to favour much exposure, and is essentially an estuarine shell. *Anapella pinguis* is common and especially plentiful in East Coast sheltered lagoons. *Notospisula trigonella* may also be observed. Other bivalves live in the Infralittoral

Fringe or below, and will be tabulated later, but some may now be mentioned. Very common on the East Coast is *Glycymeris* (*striatularis*) *suspectus* Iredale. This shell is rarely found alive and is not strictly intertidal, but is referred to here as it is especially characteristic of the East Coast. Similarly, *Tawera gallinula* (Lamarck) is very common on the East Coast, but is also found on most other beaches. *Flavomala biradiata* (Wood) is best developed with some shelter, though it is found on the exposed shores of the North Coast also. However, this species does not appear to reach beyond semi-exposed Eastern shores, such as Oyster Bay. *Electroma georgiana* (Quoy and Gaimard) is commonly found attached to weed or stones of the Infralittoral Fringe adjacent to sandy shores. An important gastropod of the North and East which should be mentioned is the well-known *Phasianella australis* (Gmelin).

3. *The Infralittoral Fringe.*

For convenience some remarks have already been made concerning this part of the sandy shore; it is now proposed to return to the rocky shore. In this area Ascidians may form a belt, while the bulk of the algal flora begins here, and provides the most notable cover for molluscs. Many also find shelter beneath stones. The fauna of this area cannot be dealt with exhaustively in this work, and only a few of the more obvious will be mentioned here. Numerous shells have been collected and are still being sorted and studied.

An important shell is *Notohaliotis ruber* (Leach), which May (1923) records from "East and South." However, it is present at West Head and elsewhere in the North. *Sabia conica* (Schumacher) is frequently found attached to this and other shells, also in semi-sheltered areas. *Mesoclanculus plebejus* (Philippi) is often found under the same stones as *Notohaliotis*, while *Macroclanculus undatus* (Lamarck) and *Euriclanculus limbatus* (Quoy and Gaimard) are more common in the East than the North; *M. plebejus* is found everywhere. Also encountered on stones are *Rissoina fasciata* Adams, *Serpulorbis sipho* (Lamarck) (semi-sheltered), *Ellatrivia merces* (Iredale), *Marginella pygmaeoides* Singleton, *Floraconus anemone* (Lamarck), *F. peronianus* Iredale (East Coast), *Austrodrillia beraudiana* (Crosse) (also on the West Coast), *Zemitrella tayloriana* (Reeve), *Z. lincolnensis* (Reeve), *Z. vincta* (Tate), *Z. acuminata* (Menke) (North and West), *Syrnola aurantiaca* (Angas), *Eulima auger* Angas (both North). Most of these shells occur in both exposed and semi-exposed localities, but the full degree of exposure is not clear in all cases. A Bass Strait shell, *Galfridus eburneus* (Petterd) has been taken by Guiler at Point Puer in the South. *Dicathais textiliosa* (Lamarck) is widespread, particularly in the North and West, favouring exposure and often higher on the shore. The Peronian *Dicathais orbita* (Gmelin) occurs on the East Coast, and occasionally on the North Coast, but not often west of the Bridport-Tamar area. May used this species for his figure (1923, Pl. 11, fig. 15). *Ischnochiton elongatus* is commonly met. *Ischnoradsia cyanida* (Sowerby) is very plentiful at exposed Northern localities. *Acanthochiton sueurii* (Blainville) occurs in sheltered places in West, North and South. Other gastropods are *Zella bedommei* (Petterd) (Coles Bay), *Fossarina petterdi* (Crosse), (South and Point Puer), and *Fossarina*

legrandi Petterd (West and South). Some of these shells live in the algae. Others better known from various algal species are *Thalotia conica* (Gray) (very common on the sheltered shore at Circular Head, also West Head, etc.), *Phasianotrochus irrisodontes* (Quoy and Gaimard), *P. eximius* (Perry) (also on the exposed Kelp weed), *Cantharidella tiberiana* (Crosse), and in Kelp roots *Scissurella ornata* May and *Scissurona rosea* (Hedley). These last two are rarely exposed, except by very low calm seas.

A number of gastropods occur on sandy shores in the Infralittoral Fringe region, some rather rarely. The most plentiful is *Bankivia fasciata* (Menke), which is washed to this position from weed. This shell is much larger on the East Coast than elsewhere. *Ectosinum zonale* (Quoy and Gaimard) is a true sand dweller, while others are *Marginella formicula* Lamarck, *M. tasmanica* Tenison-Woods, *Alocospira marginata* (Lamarck), *A. oblonga* (Sowerby), *Baryspira petterdi* (Tate), *Quibulla tenuissimma* (Sowerby), *Philine angasi* (Crosse and Fischer). Others are found alive but are accidental to this area.

It cannot be said that any of the shells of the Infralittoral Fringe have special significance except as part of the general ecology, for on rocky shores they are dependent on other dominants for shelter, though their own numbers may be considerable. Young *Ostrea angasi* may occupy this position in some numbers in sheltered waters. For example, this species is an important constituent of the edge of a mudstone platform in the West Arm, Tamar River. Sand dwellers of this area are more often below tide levels than above. As with the Olividae, they rarely approach the shore above tide level, being sand bar dwellers. The number and variety of species, though less than in northern States, are probably more significant than realised by comparison with other rocky shore dwellers, because the latter are so obvious and numerous. In this work, concern is more for the constituent individuals than for the zones and belts which serve their purpose as guides. It is, therefore, a pity that it is not possible yet to present a full census of them.

4. *The Patelloid Belt Fauna.*

Brief mention only has been made of the limpet and limpet-like molluscs, but fuller discussion is merited. *Cellana solida* is the characteristic limpet of the Patelloid Belt. It has been thought that the South Australian *Cellana rubraurantica* (Blainville) occurred in Tasmania, but Macpherson (1955) has shown that *C. rubraurantica* is a synonym of *C. solida*. Iredale (1924) assigned the name *C. solida* to the East Coast shell and expressed curiosity concerning the species on the North Coast. However, there is only one species of *Cellana* on all Tasmanian shores of sufficient exposure. *Cellana tramoserica* (Sowerby) occurs elsewhere, as discussed below. Confusion concerning *C. solida* probably first arose owing to the variability of the sculpture. Examination of numerous specimens shows that more shells with narrow ribs relatively closely spaced occur on the East Coast than on the North Coast, where broader ribs tend to predominate. On the East Coast, shells with narrowest ribs occur in sheltered places, such as Coles Bay. However, series from many localities indicate that variation is always present in some degree and has no specific

importance. True races cannot be recognised at present. Another confusing point is that young shells can be taken for a different species. Macpherson (*loc. cit.*) has pointed out that Blainville actually described *C. solida* from the young shell.

No form of *C. solida* has ribs so narrow as *C. tramoserica*, although in the case of stunted shells some doubt could arise at first sight. *Cellana tramoscerica* (Sowerby) is at the southern limit of its range on Tasmania's east coast, and, as May (1923) has observed, it is very much smaller. In appearance it is none the less typical (though only a minor constituent of the fauna), with only an occasional specimen seen on the North Coast and probably absent altogether on West and South. Its range in Tasmania may be put down as East and North-east. No large shell of this species has been seen in Tasmania, and all large eroded *Cellana* may be identified in the field without hesitation as *C. solida* (Blainville).

Very little has yet been published concerning the West Coast limpets. So far as has been observed, the essential difference between this coast and the East Coast lies in the number of individuals rather than species, so that it is thought that the Patelloid Belt is much more marked on the West Coast. The writer has seen the limpets collected by Guiler on the West Coast at Trial Harbour, but information as to their distribution has not yet been published. Near Marawah, the writer was unable to collect many live shells due to rough seas, although a large series of dead specimens was collected for comparison. At Trial Harbour, Dr. Guiler found *Cellana solida, Patellanax peroni* (including the form *P. squamifera*), *Patelloida victoriana, Patellanax chapmani, Patelloida latistrigata*, and at Fisher Island *Patelloida alticostata* and *Patellanax chapmani*. In the South, Dr. Guiler has taken *Patelloida latistrigata, Patelloida alticostata, Cellana solida*, and *Patellanax peroni*. Other species would be difficult to reach owing to the constantly surging seas. All the species mentioned above have been collected by the writer on the East Coast. On the North Coast he has collected *Cellana solida, Patelloida alticostata, Patellanax chapmani, Patelloida latistrigata*, but not *Patellanax peroni*. However, two dead specimens were taken on the west side of the Nut, Stanley.

Patellanax peroni has its habitat in the Infralittoral Fringe of the ocean rocky shores. *Patellanax chapmani*, on the other hand, occurs in areas with some degree of shelter, such as that already referred to as Kelso-north. There is some indication that *Patelloida alticostata* seeks some shelter in the West, being absent from exposed places. This may be true in the far South, but it is present in exposed places elsewhere. Dr. Guiler took it at Point Puer, although he does not refer to it when discussing Eagle Hawk Neck fauna. It should be noted that the names used are not necessarily the same as those used by Guiler, who in his earlier work followed May (1923). There appears to be some variation in the ornament of this species. *Patelloida victoriana* is especially common at Marawah on the West Coast, and may be much less important on the East Coast.

Limpets which Macpherson (*loc. cit.*) places in the family Acmaeidae (family Lottiidae in Kershaw 1955) have their habitat in the Midlittoral in sheltered areas, and in the Patelloid Belt the Infralittoral Fringe in exposed places. *Notoacmea petterdi* (Tenison-Woods) does occur at higher levels, however, and its range so far as is known to the writer is East Coast

(Bicheno), north (one specimen, West Head), North-east and West (Trial Harbour, Guiler). Macpherson (1955) indicates North-west Tasmania, although her map shows the distribution extending to a point south of Hobart. Its extension to Trial Harbour is particularly interesting, as its main distribution is Peronian.

Notoacmea scabrilirata (Angas) is found in most places which are sheltered or semi-sheltered. It is gregarious under stones, but individuals are found over most of the Midlittoral below the *Bembicium* Belt. It may be most common at lower levels, but in the West Arm at any rate, it cannot be said to be peculiar to any defined belt. In more exposed places, a limpet for which the writer uses the name *Conacmea subundulata* (Angas) is found most plentifully on bare surfaces just below the *Galeolaria* Belt. May (1923) says its habitat is estuaries and inlets, but the writer has not found it in such places in the north. Guiler, however, has found *Conacmea corrosa* Oliver in sheltered places where May also found it. *Conacmea subundulata* also appeared at Trial Harbour, and, in addition, *Notoacmaea mayi* (May). This latter species appears to have more exposure tolerance than the others. Dr. Guiler found it at Freycinet Peninsular where there is perhaps somewhat less exposure than at Trial Harbour (although one is not in a position to make comparisons), and also in the sheltered southern Barnes Bay. It seems likely that the species can withstand a fairly wide range of conditions. Also at Trial Harbour is found a small *Chiazacmea* species. At present this genus is best known in somewhat sheltered places in Tasmania by the species *Chiazacmea flammea* (Quoy and Gaimard), which seems absent from both oceanic and very sheltered coasts. In the north a variety, or subspecies, occurs at Kelso and at West Head, as well as elsewhere, for which one has continued to use the name *Chiazacmea mixta* (Reeve), although this matter may need further investigation. At Kelso-north in the estuary it lives at a low level, apparently rarely above the Infralittoral Fringe, but while it also lives in that position at West Head, it has appeared in the shelter of *Hormosira banksii* in small pools at the highest parts of the Patelloid Belt. Another subspecies, *Chiazacmea mimula* (Iredale), has been recorded from Blackman's Bay, but the writer has not seen a specimen.

The next group of the Patelloid Belt consists of species of the family Siphonariidae. From an ecological point of view it is probably best to use the generic name "*Siphonaria*" for these, as the taxonomy has been somewhat confused. Australian workers (Iredale 1940, McAlpine 1952) introduced new generic names subdividing the group, but Hubendick (1946, 1955) states that these (i.e., those with which we are here concerned) can only represent sections of the "subgenus" *Siphonaria*. The writer, however, has used these so-called genera as sub-genera of *Siphonaria*, and this would not have mattered seriously but that one of these, *Ductosiphonaria*, has to be abandoned (Hubendick 1955). Moreover, the species belonging to *Talisiphon* Iredale are regarded by Hubendick (1946) as belonging to *Pachysiphonaria* Hubendick, to which he also allots *Siphonaria funiculata* Reeve and several South American species. On this basis, *S. tasmanica* and *S. funiculata* would be placed in the subgenus *Pachysiphonaria*, but this obviously has zoogeographical repercussions. These cannot be discussed here, but merely borne in mind. Finally, Hubendick

contends that *Hudendicula* McAlpine, as already inferred above, is but a section of subgenus *Siphonaria*. Consequently *Pachysiphonaria* and *Hubendicula* cannot consistently be used on the same basis. All the Tasmanian shells would thus need to be placed in the genus *Siphonaria* if the confusion of complicated nomenclature is to avoided. The alternative is to abandon the Australian names in favour entirely of those of Hubendick. To do this would be to imply criticism of this use of these names for other Australian species, which the writer is not prepared to do, nor has he sufficient information on the Tasmanian shells to enable acceptance of Hubendick's nomenclature at present, although no criticism is here intended or implied.

Thus to aid in uniformity in Australia the writer favours, and proposes to use the genus *Siphonaria* in ecological work. The species *Siphonaria diemenensis* Quoy and Gaimard is universal in Tasmania, and there are several forms. Thus *S. dimenensis* lives on rock platforms, or large aggregations of shingle in both exposed and sheltered places. Where there are individual stones, isolated heaps, or other structures breaking up the continuity of the habitat, a form occurs closely resembling that figured as "var. *scabra*" from Port Jackson by Hubendick, but lacking the same degree of exposure tolerance. In places there are shells resembling the "var. *denticulata*" figured from the same locality (Hubendick 1946). There is a colony of "var. *scabra*" at the sheltered eastern end of the West Head, and another in what is probably the most sheltered part of the West Arm, in that the swirl of the tide does not impinge directly upon it.

Siphonaria tasmanica Tenison-Woods occurs in the entrance to the lagoon at Pipe Clay Lagoon, but this appears to be its nearest approach to a fully sheltered area. However, it also occurs in D'Entrecastreau Channel near Dover (Guiler 1952 *a*), where the shelter is considerable. It also occurs on the west side of the Nut, at Stanley, north-west Tasmania, where there is considerable exposure though not oceanic. There are certain broad resemblances between the sheltered areas in the Channel in southern Tasmania and probably other bays there, with the exposed shores of the North Coast, but the writer feels that no more significance should be attached to this than is attached to the usual tendency to find as one moves south in eastern Australia that there is a seeking out of greater shelter. *S. tasmanica* is also a constituent of the fauna at Trial Harbour, West Coast, where it is common, but less so than *S. diemenensis*. There is a subspecies, *S. tasmanica turrita* Iredale 1940, but one is unable to find evidence that this is more than a variety.

The third species, *Siphonaria funiculata* Reeve, easily recognisable by its very fine ribs, has been found in places of oceanic exposure on the East Coast. It also occurs in Oyster Bay, and young specimens were found in Coles Bay. On the North Coast it has been found at Bridport, but not elsewhere by the writer. It appears to be moderately common in the East, and probably the same may be said of the South.

NOTES ON INDIVIDUAL SPECIES.

Modiolus pulex (Lamarck).

Laseron (1956) has recently reviewed the New South Wales Mussels, and in the light of his findings it will be of interest to record here some

of the writer's observations. *Modiolus pulex* is widely distributed in Tasmania and occurs at Trial Harbour. On exposed coasts, where it occurs with *Austromytilus rostratus*, it is a minor constituent of the fauna. On the North Coast, however, it comes into its own. It is on these shores the following observations were made. The most notable development of the species is that on the granite boulders at Bridport (Kershaw 1957). Here the species dominates the Midlittoral at the expense of the barnacles. In several places *Galeolaria* is also present. No doubt this occurrence is very similar to that in western Victoria and South Australia rather than anything in other parts of Tasmania. It seems possible that a mild climate with a small amount of shelter but yet considerable wave action may be a factor in accounting for the phenomenon.

On other parts of the North Coast the shells are generally very much smaller, and may be confined to a narrow band at the lowest part of the Barnacle Belt, just above the Patelloids. This is particularly noticeable at West Head (Kershaw 1957), but the shells are somewhat larger in some localities further along the North-west Coast. May (1923) has figured a shell from "brackish water estuaries" as *M. confusus* (Angas), but shells as large as this are not common, at least in North Coast localities. The shells found in the West Arm of the Tamar River, for example, are of the same size and appearance as shells from Bridport on the average. Among them, however, are occasional much larger shells of slightly different shape, which could be labelled *M. confusus*. There is not sufficient scientific evidence to substantiate the separation of an estuarine shell as a separate species. A series of forms shows reactions to their respective environments. As Laseron (*loc. cit.*) points out, these forms are not even racial. The large shells are apparently specimens which for some reason have made very vigorous growth. There is no point in retaining the name *M. confusus* in Tasmania.

Modiolus cottoni Laseron.

This is the species which the writer (1955) recorded as *M. spatula* Lamarck, but which he could not regard as satisfactory. In the writer's opinion, Lamarck used the word "spatule" in a descriptive sense without intending to name the "variety," but one is not in possession of all the facts. Iredale (1924) quoted Tate's words concerning a var. *spatula* Lamarck, and this seemed the only name available. Cotton and Godfrey (1938) and Laseron (*loc. cit.*) have also quoted Tate's words, but presumably the name has no value. As Laseron has provided a new name for shells which he states cannot be separated from eastern Tasmanian shells, it is proposed to discard *M. spatula* from the Tasmanian List in favour of Laseron's name. As it happens, the writer was fortunate enough to obtain a juvenile specimen alive on the rocks at Bridport. This situation was a small pool in the *Modiolus pulex* belt on the jagged metamorphosed Silurian series (not the granite), which make up the rocky shore at Bridport. An adult specimen was also found, but this was dead. These shells show that the species (as Laseron believes) is hirsute, and the hairs are not forked. May's (1923) figure is not a good one, and the writer's shells are not precisely identical with Laseron's figure. The differences are probably accounted for in both cases by the fact that the shells are from the North Coast, and not the East Coast. Cotton (1957) figures an hirsute South Australian shell.

Modiolus delinificus Iredale.

Laseron (*loc. cit.*) accepts this name in place of *M. albicostus* Lamarck, and it is intended to do likewise, as the type is May's shell (1923). It is mentioned here because it is found on sandy beaches (May states "many beaches"), although as the writer has not found it alive he assumes that it lives below low tide in Tasmania also. Laseron is hardly correct in confining it to ocean beaches, for one has found it in Prosser Bay, which certainly faces the Pacific, and on the North Coast, which does not. Presumably "ocean" is a pen slip for May's word "many."

Venerupis crenata Lamarck.

This is an example of a northern shell which is found in very sheltered waters in northern Tasmania. Very many examples have been studied *in situ* in the West Arm, Tamar River, and in not one instance could it be claimed that there was evidence that the mollusc had itself bored the hole in which it was found. The rock is a Permian pebbly mudstone or normal mudstone on various parts of the shore. Where pebbles have been removed by erosion, or where joints occur, the resulting cavities have been infilled with mud. In such places *Venerupis crenata* is commonly found. Distortion is common, but there are two noticeable forms of this which may be spoken of respectively as an elongate, more or less normal form, and an abbreviated form which tends to obesity.

Austrocochlea constricta (Lamarck).

There is some doubt as to the status of this species and *A. obtusa* (Dillwyn), with the suggestion that one of these may have only subspecific or varietal value. Endean, Kenny, and Stephenson (1956) have placed *A. obtusa* as a subspecies of *A. constricta*, but this seems unnecessary as *A. obtusa* has priority by several years, although *A. constricta* happens to be type species of the genus. In Tasmania these shells occupy two types of habitat, which only appear to overlap in certain places, such as the Tamar Estuary. As there is some variation throughout the group of forms sometimes included in *Austrocochlea*, it may be of interest to review the occurrence of the various species as they appear in the Tamar Estuary, and the headland, West Head, near the mouth.

West Head (see Kershaw 1957) is an exposed North Coast rocky shore. The most plentiful *Austrocochlea* is *A. constricta*, which is common on exposed Tasmanian shores, and is found over most of the shore. It appears first high in the Midlittoral, and is soon accompanied by *A.* (*Fractamilla*) *concamerata* (Wood). *Fractamilla* is now being given generic status by some. This species occurs on this part of the shore as a large shell with a prominent apex. At the foot of the Midlittoral at West Head, this form is not found alive, but another form takes its place. This second form is much smaller, and the apex is flattened, and will be termed "Form 2" for convenience. In this same part of the shore there is also found *A.* (*Chlorodiloma*) *odontis* (Wood), while perhaps in general slightly lower still, *A.* (*C.*) *adelaidae* (Philippi) is rather less common than its congener.

At Kelso-north, inside the estuary, *A. constricta* appears in small numbers well down in the Midlittoral, and may be found as far as the north end of Kelso Bay, but very rarely further, probably only accidentally. At the same time, *A. obtusa* appears on the sand flats in numbers over most of

the Midlittoral. The shell found here is a small form, about half normal size, and is probably the estuarine form of the species. In Kelso Bay this form becomes very common on the *Zostera* beds. At the south end of Kelso Bay there is a small outcrop of rock. At this point the rock fauna has shown a marked alteration to sheltered forms. The prominent *Austrocochlea* is now Form 2 of *concamerata* and the shell is very similar in general appearance except that it is now normally double the size of the normal West Head individuals, and the colours differ. In these areas, *A. odontis* is also present.

In the West Arm the upper shore has the estuarine form of *A. obtusa* with numbers of smaller shells which may be juveniles, while lower on the shore are shells which are near the normal form of *A. obtusa* in Tasmania. These are not as big as the bay shells of the East Coast nor as colourful. It is interesting to note that among shells from Boat Harbour, East Coast, both forms of *A. obtusa* appear, while the large Form 2 of *A. comcamerata* appears with a smaller shell very similar to what could have been called Form 1 of this species from West Head, although there is considerable difference in size in the specimens to hand. The "normal" *A. obtusa* from Boat Harbour distinctly recalls striped New South Wales shells. At Prosser Bay *A. obtusa* grows larger still, about one inch, and has a distinctive red tinge in this sandy East Coast bay. Variation of colour and pattern are normally expected with this species, so that the only noticeable point is the general drabness of estuarine specimens. It is doubtful whether this species ever occurs in one position in Tasmania in such numbers as appear in New South Wales.

Subninella undulata (Solander).

In Tasmania this species has two forms which are interesting from an ecological point of view, as one appears to occur mostly in exposed situations, while the other favours some shelter. The exposed shell is heavier and stronger, with elevated apex, well known in Tasmania, particularly on the East Coast. The form favouring some shelter (e.g., no more than is found at Kelso-north, Tamar River) is very like the common South Australian *Subninella undulata*, but never grows so large in Tasmania as far as the writer knows. Dr. Guiler obtained this form at Trial Harbour on the West Coast.

Lepsithais vinosa (Lamarck).

It is well known that this species is variable, hence it is of interest to find that certain variations appear to occur in definite situations. The writer has found that one form occurs only in sheltered places, and another in exposed places on all coasts in Tasmania from which shells have so far been examined. Hence it has been possible to refer to an exposed form and a sheltered form in field notes. It may be that other variations will become apparent.

INTERTIDAL MOLLUSCS OF CERTAIN LOCALITIES ON TASMANIAN COASTS.

Before presenting a tabular summary of the more important species studied, the localities at which they were observed are discussed. In the list of references at the end of this paper attention is drawn to various essays by Guiler relating to southern and eastern Tasmanian localities. Reference should be made to these for details not mentioned here.

West Coast.

As Dr. Guiler's results from Trial Harbour are not published, he kindly allowed the writer to make use of his molluscan collections in this work. Brief comment on these may be made at this point. Trial Harbour is on the West Tasmanian coast, somewhat south of the Pieman River. The rocks in the vicinity include Palaeozoic granite and Cainozoic sediments. The mollusca collected indicate two types of fauna, an exposed and a semi-exposed fauna, and these were obtained at two different places. Both groups are related to faunas from other parts of Tasmania and little individuality is noticeable. There is a suggestion of Flindersian influence, which is to be expected.

There are several species additional to those found on the North Coast, but these are such as would be expected on an oceanic coast, and are mostly present on the East Coast. One point of interest is the presence of *Austromytilus rostratus* in the exposed area and *Austromytilus erosus* in the more or less sheltered area. *A. rostratus* is an ocean coast species, but *A. erosus* occurs in semi-sheltered waters in the North and sheltered water in the East. *Patellanax chapmani* (T.-Woods) occurs in both areas and is recorded from the North Coast, but appears to be absent on the East.

North Coast.

At Stanley, collections were made on the massive dolerite headland known as the Nut. The western aspect grades from semi-exposed to exposed, with considerable wave action. Thus *Melaraphe* is hardly present as a belt at first, but becomes increasingly important until it is well developed over a considerable distance, particularly on vertical rock faces furthest out on the headland. There is a suggestion of relationship to the fauna of more exposed coasts with the presence of *Siphonaria tasmanica* and *Notoacmea petterdi*, the former absent and the latter rather rare further east on the North Coast. *Modiolus pulex* is not particularly well developed, but was found to be very plentiful near Wynyard further east. On the eastern aspect of the Nut, the exposure grades into much more shelter, and muddy flats occur with *Salinator solida* and *Anapella pinguis*, followed by scores of the little soldier crab *Mictyris platycheles*. East of this point a wide sandy beach develops with appropriate fauna. The North Coast appears to be distinguished by the presence of such species as *Uber aulacoglossa* (Naticidae), *Laternula creccina* (Laternulidae), *Eucrassatella kingicola* (Crassatellidae), *Venerupis galactites* (Veneridae), *Amphidesma nitida* (where more shelter), and these appear to be absent on other sandy shores.

West Head has been described by the writer (1957), and Green's Beach east of the headland is similar to that at Stanley, except that *Eucrassatella kingicola* may not be present.

One has already referred frequently to localities within the Tamar River. These grade from semi-exposure to sheltered to very sheltered waters. Wide sand flats alternate with considerable areas of dolerite shingle north of Kelso. *Zostera nana* forms a wide belt on the sand, and is commonly seen at many places in the Estuary towards Launceston. Kelso Bay, south of Kelso, has a wide *Zostera* belt with numerous *Austrocochlea*

obtusa, etc., and passes into very sheltered mud flats with *Salinator solida* at one point, while at another a fresh water spring ensures the presence of a small population of *Ophicardelus ornatus*. At the southern end an outcrop of Permian till shows the effect of a small degree of exposure with the re-development of the more northern fauna (Tamar) and the presence of a *Melaraphe* belt. South of this point the shore shows a marked estuarine trend.

West Arm is several miles within the estuary near Beauty Point, and is very sheltered, with very small wave action. There are mud and sand flats, with Permian mudstone platforms. The geology has been reviewed by the writer (1955). There is a good deal of resemblance to Pipe Clay Lagoon (Guiler 1951) and a direct comparison is made between these two localities in Table 2. The presence of the mudstone platforms, however, introduces an additional element, for there is little by way of firm substratum in the southern locality. At West Arm *Venerupis crenata* and *Onchidella patelloides* are numerous and assist in adding individuality to this locality. *Velecumantus australis* is very numerous, and is the dominent species on parts of the shore. It is present in Kelso Bay and on parts of the East Coast in shelter. It is more common again at Port Arthur, where there are very sheltered mud flats, and is present in Pipe Clay Lagoon. In West Arm at one point there is an important occurrence of *Galeolaria caespitosa*, the tubes of which provide much shelter and are favoured by *Onchidella*. A curious feature of the West Arm is the tolerance of its fauna to considerable variation in salinity, and sometimes to turbidity. The crab *Mictyris* is also numerous here.

At Bridport several types of shore exist. The Brid and Forester Rivers form a small estuary, which widens near the mouth into a small sandy bay. Above the beach there is some marshy ground, with pools where *Salinator solida* is present. East of the mouth there is unbroken sandy beach, while to the west the beach is littered with granite boulders, some of large size. Further west there is a rocky shore of Silurian metamorphic sediments. A feature of the rocky shores is the development of *Modiolus pulex*. The sandy beach is distinguished by the presence of considerable numbers of *Cardium racketti* and *Glycymeris* (*striatularis*) *suspectus* Iredale, which is in reduced numbers westerly. *Glycymeris flabellatus* Tenison-Woods also appears here. Another important North Coast bivalve which appears here is *Macoma deltoidalis* (Family Tellinidae), which is more common in sheltered areas, such as West Arm, than on the exposed beaches, where it lives lower on the shore.

East Coast.

Ocean beaches bring a considerable increase in the numbers of *Glycymeris suspectus*, so that dead valves are extremely common. The species has its habitat principally below low tide level, and is mentioned only because it is so common. All Tasmanian sandy beaches with any degree of wave action are distinguished by the presence of *Uber conicum*, *Amphidesma spp.*, *Austromactra rufescens*, *Tawera gallinula* associated with *Katelysia scalarina*, *Flavomala biradiata*, *Anapella pinguis*, etc., the last named species becoming more common with shelter. Species deserving notice in addition to those listed in Table 2 are *Solen vaginoides* *Callanaitis disjecta* and *Placamen placidum*. The last-named is commonly observed alive on exposed

beaches. It is probably a dominent or co-dominant of the lowest Midlittoral of some shores.

George's Bay at St. Helens is a sheltered bay, the flooded south of the river, with wide tidal mudflats. Another such muddy estuary is Little Swan Port. These have typical sheltered faunas which do not here need elaboration. East Coast lagoons are similar on a smaller scale, with the difference that these commonly have a marshy salt flat with volunteer succulents and a population of *Salinator solida* in the Supra-littoral, while the dominant Midlittoral bivalve is *Anapella pinguis*.

A fully exposed quartzite reef was examined on the sandy shore near Scamander. The dominant midlittoral mollusc was *Austromytilus rostratus* forming a dense mat on the side of the rock face, and hence not bearing the full brunt of the wave action. On a flat surface at a lower level the surf barnacle *Catophragmus polymeris* was conspicuous. Patelloids observed included *Cellana solida, C. tramoserica, Siphonaria tasmanica, S. funiculata*. There was no *Melaraphe* belt, but some individuals adhered to the mussels. The highest species was the barnacle, *Chthamalus antematus*, as the summit of the rock surface in any case probably did not reach the Supralittoral Fringe. In addition, the smooth rock surface made it unsuitable for *Melaraphe*.

At Bicheno the shore is of massive granite, the smooth surface of which is pounded by oceanic wave action. *Melaraphe unifasciata* individuals are very robust, but not plentiful. The upper shore has few individuals, but *Sypharochiton maugeanus* and *Austrocochlea concamerata* were observed near the top of the barnacle belt. *Austromytilus rostratus* follows and subsequently the Patelloids. The shore from the lower parts of the Barnacle Belt rapidly gains in numbers of species and individuals until there are dense populations in which the usual molluscs are ingredients.

In Oyster Bay the rocky shore of dolerite has dense populations of *Austromytilus rostratus*. The most noticeable point with reduction in exposure is the absence of the surf barnacle *Catophragmus*. So far as molluscs are concerned, there are generally more individuals on the higher parts of the shore. However, this generalisation does not apply in some places. On the granite of Cole's Bay, with even less exposure, there are markedly fewer *Austromytilus*, but many more gastropods in the Midlittoral

At Orford, Prosser Bay, the sandy shore yielded a large number of bivalves, and a number of large *Austrocochlea obtusa*. *Katelysia corrugata* and *Eumarcia fumigata* become more noticeable members of the fauna, but there is a more noticeable southern influence in the sub-tidal fauna of bivalves.

At Eagle Hawk Neck there is a sheltered sandy shore fauna on the western side, and an exposed fauna on the East. This, of course, applies also to the rocky shores which are of dolerite and mudstone. At Dunalley the sheltered sandy shore fauna is again present. The sheltered shore species, which may be very common in such places, are rare on the surf beaches.

South Coast.

In the Port Arthur area there is a range of conditions from maximum shelter to maximum exposure at, say, Cape Pillar. At Port Arthur the "sheltered" bivalves *Anapella pinguis* and *Katelysis scalarina* are again part

of the fauna. *Velacumantus australis* is present on the mud surface. The area has been dealt with by Cribb (1954) from an algal point of view, and he deals in a general way with the fauna. Despite the apparent shelter, Port Arthur is similar to Cole's Bay in possessing a semi-exposed molluscan fauna. Thus there are found *Cellana solida, Siphonaria tasmanica, S. diemenensis Notohaliotis ruber*, while *Austromytilus rostratus* packs fissures and below these *Mytilus planulatus* is also present. At Point Puer the dolerite rocks are semi-exposed, and support a typical fauna, such as is present on all coasts, showing some degree of exposure and wave action (typified by the presence of a defined *Melaraphe* Belt). Guiler (1952 *b*) has given brief notes on this locality, and the writer has had the opportunity of studying the molluscs collected here by him. The species are those found on the East Coast, but *Fossarina petterdi* and the bivalve *Hiatella australis* may be mentioned.

The sandy shores of Frederich Henry Bay have considerable shelter near Dunalley, but near the entrance to Pipe Clay Lagoon a typical sandy exposed beach fauna was obtained with the addition of *Psammobia livida* and *Electromactra flindersi*, but without *Callanaitis disjecta*. A similar fauna exists at Sandy Bay near Hobart, and here *Katelysia scalarina* and *K. corrugata* are robust shells. *Venerupis diemenensis* is also an addition on these southern shores.

The rock faunas of the Derwent area and D'Entrecastreau Channel bays have been dealt with by Guiler (1950, 1952 *a*) and South Cape Bay (1954 *b*). This latter area has a high degree of exposure, but the usual molluscs are present, although *Melaraphe* is hardly developed as a belt, which is due to the nature of the platform and the absence of a Supralittoral Fringe as such. *Siphonaria diemenensis* is apparently especially plentiful, and is accompanied by *S. tasmanica*, but *Cellana solida* is rare in some places. Guiler (1954 *b*) has reported on a rather different type of shore in the South Cape Bay localities in that algae dominate the intertidal area. It is therefore a pity that no molluscs are available from points further west, because if differences from the typical Tasmanian molluscan fauna exist, they will be found in the south-west corner.

A tabular summary of the species is presented in Table 2, where abbreviations are used as follows:—Supralittoral Fringe (S.L.F.), Midlittoral (ML), Infralittoral Fringe (ILF), Dominant (D), Common (C), Present (P), Victoria (V), New South Wales (N), South Australia (S), and Queensland (Q).

The nature of the substratum is noted briefly after each species name. Occurrences in mainland States are included for comparison.

Principal species of Mollusca found on Tasmanian shores.

Gastropoda. Species and substrate.	Place on Shore	West		North			East			South			Max. Shelt.			Victoria	South Australia	New South Wales	South Queensland
		Exposed	Semi-exposed	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	West Arm	Pipe Clay Lagoon	East Coast Lagn.				
Haliotidae																			
Notohaliotis ruber (Leach) rocks	ILF	P	...	C	...	...	P	C	...	P	P	...	...	...	...	V	S	N	
Scissurellidae																			
Scissurella ornata May algae	ILF		..	.	.	.	P			P		.	..	..		.	.	N	.
Fissurellidae																			
Scutus antipodes Montfort rocks	ML	...		P	...	...	P	...		P	.	..		...	..	V		N	Q
Montfortula conoidea (Reeve) rocks (*Galeolaria* Belt)	ML	...	...	C	P	...	...	C	...	...	C	...	...	...	...	V	S	..	Q
Montfortula rugosa (Quoy and Gaimard) rocks, (*Gal.* Belt)	ML	P	...	P	...	...	...	P	...	...	..	...	...	...	...	V	S	...	
Sophismelepas nigrita (Sowerby) rocks	ILF	...	...	P	...	...	...	...	...	...	...	...	...	...	...	V	S	N	..
Patellidae																			
Patellanax peroni (Blainville) rocks	ILF	C	...	P	...	...	C	...	...	...	...	...	...	...	...	V	S	N	.
P. chapmani (T. Woods) rocks	ILF	P	P	P	...	...	...	...	...	...	...	...	...	...	...	V	S	.	...
P. victoriana Singleton rocks	ILF	P	.	..	..	.		..		P	...		...			V	S	.	...
Cellana solida (Blainville) rocks (Patelloid Belt)	ML	C	..	D	..		C	P	P	C	P	P		.	...	V	S		..
C. tramoserica (Sowerby) rocks	ML			P	.	..	P	.		...	...	...	..	...	...	V	S	N	Q

		West		North			East			South		Max. Shelt.						
	Place on Shore	Exposed	Semi-exposed	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	West Arm	Pipe Clay Lagoon	East Coast Lagn.	Victoria	South Australia	New South Wales	South Queensland
Acmeidae																			
Patelloida alticostata (Angas) rocks	ML		P	C	P	...	P	C	...	P	P	P				V	S	N	.
P. latistrigata (Angas) rocks (Patelloid Belt)	ML	P		P	...	...	P	...	...	P						V	S		
Chiazacmea flammea (Quoy and Gaimard) rocks	ML				P	...	...	P				P				V	...	N	.
Notoacmea mayi (May) rocks	ML		P				P	P	...	...	P			.		V	.	.	..
Notoacmea petterdi (T. Woods) rocks	ML	P		P	...	...	C	...	...	...	P	..			.	V		N	Q
Notoacmea scabrilirata (Angas) rocks	ML		P						P	.		P	C	.		V	S	N	.
Conacmaea corrosa Oliver rocks	ML			.			.	..	..	P	P					..	...	...	...
C. subundulata (Angas) rocks	ML	P	.	C	P							P		C		...	S	N	.
Actinoleuca calamus (Crosse and Fischer) rocks	ILF	P		P	P	...	P	...	...	P		.			...	V	S		...
Trochidae																			
Macroclanculus undatus (Lamarck) rocks	ILF			P	...	...	...	C	...	...	P					V	S	N	..
Mesoclanculus plebejus (Philippi) rocks	ILF		.	C	...	...	...	C	...	...	C		.		.	V	S	N	..
Phasianotrochus eximius (Perry) algae	ILF	.	..	C		..	..	C	...	...	C	...	.	...	...	V	S	N	...

(Dunker) algae																					
Thalotia conica	ILF			P	C												V	S		
(Gray) algae																					
Bankivia fasciata	ILF			C			C			C							V	S	N	
(Menke) algae																					
Austrocochlea obtusa	ML		P		P	D			C			C	C	D	C	V		N	Q	
(Dillwyn) sand, mud																					
A. constricta	ML			C	P		C			C	C					V				
(Lamarck) rocks																					
Fractamilla concamerata	ML		P	C	C		C	C	C	C						V	S	N		
(Wood) rocks																					
Chlorodiloma odontis	ML	P		C	P		C	C			P	P				V	S			
(Wood) rocks																					
C. adelaidae	ILF			P	P		P									V	S			
(Philippi) rocks																					
Fossarina legrandi	ILF	P					P			P						V	S	N		
(Petterd) rocks																					
F. petterdi	ILF	P								C	C					V	S			
(Crosse) rocks																					
Stomatellidae																					
Herpetopoma baccata	ILF			P				P								V		N		
(Menke) rocks																					
Turbinidae																					
Subninella undulata	ML	P		C	C		P	C		P	C					V	S	N	Q	
(Solander) rocks, sand																					
Micrastraea aurea	ML		P	C				P			P					V	S			
(Jonas) rocks																					
Eutropidae																					
Phasianella australis	ILF			C	C			C			C	C				V	S			
(Gmelin) algae																					
Mimelenchus ventricosa	ILF			C												V	S	N		
(Swainson) algae																					
Neritidae																					
Melanerita melanotragus	ML	P		D	P			P								V	S	N	Q	
(Smith) rocks																					

		West		North			East			South			Max. Shelt.						
	Place on Shore	Exposed	Semi-exposed	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	West Arm	Pipe Clay Lagoon	East Coast Lagn.	Victoria	South Australia	New South Wales	South Queensland
Littorinidae																			
Melaraphe unifasciata (Gray) rocks	SLF	D		D	P	P	D	P		D	P		P			V	S	N	Q
M. praetermissa (May) rocks	SLF			P			P	.		P	..	..	..	..	.	V	S	.	...
Bembiciidae																			
Bembicium melanostomam (Gmelin) rocks	ML		..		P			P			.	C				V	S	N	Q
B. auratum (Quoy and Gaimard) rocks	ML	..			..	P			P	...		P	D	P		V		N	
B. nanum (Lamarck) rocks	ML	P		C	P		C	P		P	P		.		.	V	S		..
Assiminidae																			
Assiminia brazieri (T. Woods) mud, rocks	ML				C	C			P	.			C	D	P	V	S		
Vermetidae																			
Serpulorbis sipho (Lamarck) rocks, stones	ILF		P		P			P	.	.						V	S	N	
Cerithidae																			
Zeacumantus diemenensis (Quoy and Gaimard) sandy mud	ML		P	..	C		...	..	...	..			.	...	.		.	..	...
Rubittium lawleyanum (Crosse) sandy mud	ML				C	D				.			D	D	P	V	S	..	..
Cacozeliana granarium (Kiener) sand	ML				D	.		.	.	..						V	S		..
Velacumantus australis (Quoy and Gaimard) mud	ML				P	P		...	P			P	D	P	...	V	...	...	...

Sabia conica (Schumacher) shells, etc.	ILF		P	P	P		P	P	..	...	.			...	.	S	...	..		
Naticidae																				
Uber aulacoglossa (Pilsbry and Vanatta) sand	ML	...	...	P	P			.	.	.		P		..	V	S	N			
Uber conicum (Lamarck) sand	ML	P	...	C	C		P	C	.	.	C	.	.	P	V	S	N	Q		
Ectosinum zonale (Quoy and Gaimard) sand	ILF	...	...	P	..	.	...	P			.				V	S	N			
Cymatiidae																				
Cymatilesta barthelemyi (Bernardi) rocks	ILF	.		P		..	P	P	...					...	..		.	..	.	
Charonia rubicunda (Perry) rocks	ILF	..	.					P	.		.			..		...		N	..	
Negyrina subdistorta (Lamarck) rocks	ML	..	...	P	.	.	..	..	...	..					..	V	S	.		
Cymatiella verrucosa (Reeve) rocks	ILF	.	P	P		.	.	...		.	.		.		..	V	S	..		
Muricidae																				
Pterynotus triformis (Reeve) rocks	ILF	..	...	C	P			P	.	.					...	V	S	.	.	
Galfridus eburneus (Petterd) rocks	ILF	...	...	P	.		..	P	.	.					...	V	S	..	.	
Thaididae																				
Dicathais orbita (Gmelin) rocks	ILF	...	...	P			C	C	.		.	.	.		.	V	.	N	Q	
D. textiliosa (Lamarck) rocks	ILF	P	..	C	.			..		..					..	V	S	..	.	
Neothais baileyana (T. Woods) rocks	ML	...	...	P		...		.		P	.			..		V	S	...	..	
Lepsithais vinosa (Blainville) rocks	ML	P	P	C	C	C	C	P	P	..	P		C	.	.	V	S	N	.	
Lepsiella reticulata (Lamarck) rocks	ML	.	..		.	.	C	.	..	.	P	.			.	V	S	..	.	

		West		North			East			South			Max. Shelt.					
	Place on Shore	Exposed	Semi-exposed	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	West Arm	Pipe Clay Lagoon	East Coast Lagn.	Victoria	South Australia	New South Wales	South Queensland
Agnewia tritoniformis (Blainville) rocks	ML		.	P	..			P	..	.	P		..	.		V	...	N	.
Pyrenidae																			
Zemitrella semiconvexa (Lamarck) rocks	ILF	...		C	P			P		.			..			V		N	.
Zemitrella lincolnensis (Reeve) rocks	ILF		.	P			...	P			P	.	.			V	S	N	.
Z. tayloriana ..... (Reeve) rocks	ILF	...			..	.	..	P	P		P	.	.		..		...	N	.
Z. vincta .... (Tate) rocks	ILF	..		P	.			P			P	..	...	..	.	V	S	...	...
Z. acuminata (Menke) rocks	ILF	...	P		.		..	...	...	.	..	.	..	...	...	..	..	...	...
Zella beddomei ..... (Petterd) rocks	ILF	..	.	..	..	..	..		P	.	..	...	.	.	.	V	...	.	...
Buccinidae																			
Cominella eburnea ..... (Reeve) rock, sand	ML			..	C			C				.	..	.	...	V	S	...	..
C. lineolata ..... (Lamarck) rock, sand, *Zostera*	ML	P	P	C	C	C	C	C	C	C	C	C	P	P	..	V	S	.	..
C. acutinodosa ..... (Reeve) sand, mud	ML	..	.		C	P	.				...		P	.	..	V	S	..	...
Tasmeuthria clarkei ..... (T. Wood) rocks	ILF	..	..	.		.	.			.	P	..	..	...		V	S	.	..
Fax tenuicostata ..... (T. Woods) rocks	ML	P	..		.	...	P			P	.	...	.	..	...	...	.	...	...

(Gray) rocks																			
Nassariidae																			
Parcanassa burchardi (Philippi) sandy mud	ML				C	C							C			V	S	N	
P. pauperata (Lamarck) sand, muddy sand	ML				C	C			C			P	P	C		V	S	N	
Fasciolariidae																			
Pleuroploca australasiae (Perry) rock, sand	ML			P	P			C			C		P	C		V		N	
P. coronata (Lamarck)	ML			C	C	P										V	S	N	
Propefusus pyrulatus (Reeve) rocks	ML			P												V		N	
P. undulatus (Perry) rocks	ML			P							P	P				V			
Olividae																			
Alocospira marginata (Lamarck) sand	ILF										P						S		
Alocospira oblonga (Sowerby) sand	ILF			P												V			
Baryspira petterdi (Tate) sand	ILF			P												V	S		
Mitridae																			
Mitra glabra Swainson rocks	ILF			P				P								V	S	N	
Mitra rhodia Reeve rocks	ILF		P	P												V	S	N	
Volutidae																			
Amoreria undulata (Lamarck) sand	ILF			P				P			P					V	S		
Lyria mitraeformis (Lamarck) sand	ILF			P												V	S		
Marginellidae																			
Marginella formicula Lamarck sand	ILF							C	P		C						S		

Place on Shore	West		North	East		South		Max. Shelt.			
	Exposed	Semi-exposed	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	West Arm	Pipe Clay Lagoon	East Coast Lagn.	Victoria	South Australia	New South Wales	South Queensland
M. muscaria	ILF	.	.	.	.	C	C	.				V	S	N	.
Lamarck sand															
M. pygmaeoides	ILF	...	...	P		P	P	P				V	S		
Singleton rocks															
M. tasmanica	ILF	.	.	.	P							V	S	N	
T. Woods sand															
Turridae															
Austrodrillia beraudiana	ILF	...	P	P	P	.						V		N	
(Crosse) rocks															
Conidae															
Floraconus anemone	ILF	..	P	C	P		C					V	S		
(Lamarck) rocks															
Bullariidae															
Quibulla tenuissima	ILF	..	..	P	P		P					V	S	N	
(Sowerby) sand															
Philinidae															
Philine angasi	ILF	.	.	C	.		P	C	.	C	.		V	S	
(Crosse and Fischer) sand															
Elobiidae															
Ophicardelus ornatus	SLF	.	.	.	P		.	P			C		V	S	N
(Ferussac) rock, muddy sand															
Onchidiidae															
Onchidella patelloides	NIL	P	.	P	.	P	.	.			C		V	.	N
Quoy and Gaimard rocks															

Amphibolidae																						
Salinator fragilis	ML				C	C	.	.	C	...	...	..	D	C	...	V	S		...			
(Lamarck) muddy sand, *Zostera* Belt																						
S. solida	ILF					D			C	...	.	..	D	D	D	V	S	..	..			
(Martens) mud, sand																						
Siphonariidae																						
Siphonaria diemenensis	ML	C	.	D	C	C	C	C	C	C	C	C	C	..	...	V	S	N				
Quoy and Gaimard rocks																						
Patelloid Belt																						
S. tasmanicus	ML	P		P	...		C	..	.	...	P	P	...	...	...	V	S		.			
T. Woods rocks																						
S. funiculata	ML		.	P			P	P	P	...	...	P			.	.	S	.	..			
Reeve rock																						
Pelecypoda																						
Arcidae																						
Arca pistachia	ILF		P	C	P			P								V	S	N				
Lamarck rocks																						
Glycymeridae																						
Glycymeris (striatularis) suspectus	ILF		.	C			C			.		P		.			.		.			
Iredale sand																						
Vulsellidae																						
Vulsella vulsella	ILF			P				P	..								..	N	.			
(Linne) rocks (sponges)																						
Vulsella spongiarum	ILF			P					.					.		V	S					
Lamarck rocks																						
Pinnidae																						
Atrina tasmanica	ILF			P			..		..	...						V	.					
(T. Woods) sand																						
Pteriidae																						
Electroma georgiana	ILF			C				.	C	P	.	P	P			V	S		.			
(Quoy and Gaimard) algae																						
Ostreidae																						
Ostrea angasi	ILF					P				P	...	..	P	P				N				
Sowerby rock, mud																						

	Place on Shore	West		North			East			South			Max. Shelt.						
		Exposed	Semi-exposed	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	West Arm	Pipe Clay Lagoon	East Coast Lagn.	Victoria	South Australia	New South Wales	South Queensland
Trigonidae																			
Neotrigonia margaritacea (Lamarck) mud, sand	ILF			..	P	P		..	P	P		.		.		V		N	.
Pectinidae																			
Mimachlamys asperrima (Lamarck) sand, sponges	ILF			.	P	P	.	..	P	..	.		P			V	S	N	
Limidae																			
Pelecypoda																			
Species																			
Australima gemina Iredale rocks	ILF	.		P	..		..		...	...	.		.	.	.		S		
Anomiidae																			
Monia ione Gray rocks	ILF		.	P			..	P	..		P	..			.	V	S	N	.
Mytillidae																			
Mytilus planulatus Lamarck rocks	ML			.	..	...	.	C	C		C	C		P	...	V	S	N	.
Austromytilus rostratus (Dunker) rocks	ML	C	.	..	.	.	D	D		D	D	.	.	P	.	V	S	N	...
A. erosus (Lamarck) rocks, sand	ML	...	P	..	C	P	.	..	...	.	...	.	...	...	.	V	S	...	.
Modiolus delinificus Iredale rocks? not taken alive				P	P	..	P	..	..	...	..					V	S	N	.
M. cottoni Laseron rocks, 1 sp. Bridport alive	ILF		P	P	.	.	...	...	..		...	.			.	V	S	N	

Laternulidae																					
Laternula creccina	ILF			P	C											V	S	N			
(Reeve) mud, sand																					
L. tasmanica	ILF											P	C								
(Reeve) mud																					
Crassetellidae																					
Eucrassatella kingicola	ILF			P												V		N			
(Lamarck) sand																					
Leptonidae																					
Kellia australis	ML	P		C	P	P	P			C	P	P				V	S	N			
(Lamarck) rocks																					
Lucinidae																					
Wallucina assimilis	ML													P		V		N			
(Angas) sand																					
Cardiidae																					
Cardium racketti	ILF			C	P			P			P					V	S	N			
Donovan sand																					
C. cygnorum	ILF			P							P					V	S	N			
Deshayes sand																					
Veneridae																					
Dosinia coerulaea	ILF			C			P	P			P					V		N			
(Reeve) sand																					
Paradione kingii	ILF			P			P	P			P					V	S	N			
(Gray) sand, rare alive																					
Pelecypoda																					
Species																					
Paradione diemenensis	ILF			P				C								V					
(Hanley) sand																					
Callanaitis disjecta	ILF			C				P								V	S	N			
(Perry) sand																					
Placamen placidum	ML			C			C	C			P					V	S				
(Philippi) sand																					
Tawera gallinula	ILF			C	P		C	C								V	S	N			
(Lamarck) sand																					

		West		North			East			South			Max. Shelt.						
	Place on Shore	Exposed	Semi-exposed	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	West Arm	Pipe Clay Lagoon	East Coast Lagn.	Victoria	South Australia	New South Wales	South Queensland
T. lagopus (Lamarck) sand	ILF	.	.	P	.	.	P	P	.		...	.	.	.	.	V	S	N	.
Venerupis exotica Lamarck sand	ILF	.		P			P		.		P	...	.		...	V	...	...	...
V. diemenensis Quoy and Gaimard sand	ILF	.		.		.				.	P	.		P	.		.	...	...
V. crenata Lamarck rock	ML			...		C				...		.	C		.	V	S	N	...
V. fabagella (Deshayes) sand	ILF		.	P		.	.	P			.					V	...	N	...
V. galactites (Lamarck) sand	ILF			P	P			.	...		..			.		V	S	N	.
Katelysia scalarina (Lamarck) sand, muddy sand	ML			P	P	C	P	P	P		.	C	D	D	P	V	S	N	.
K. peroni (Lamarck) sandy mud	ML		.	..	P	t	.			...	..	...	D	...	..	V	S	...	...
K. corrugata (Lamarck) sand	ML			.			P			..	..	C	.	D	.	..	S	...	...
Eumarcia fumigata (Sowerby) sand	ILF			P	.			P	...	..	P	...	..	...	...	V	S	N	..
Tellinidae *Tellina albinella* (Lamarck) sand	ILF		.	P	.			P	.	..	P	..	..	..	...	V	S	N	.
Macoma deltoidalis (Lamarck) sand, sandy mud	ML			P	P	P				..		.	C	..	...	V	S	..	...

(Wood) sand, sandy mud																				
Psammobia livida	ML										C					V	S	N		
Lamarck sand																				
Solenidae																				
Solen vaginoides	ILF			P			C				P					V	S	N		
Lamarck sand																				
Mactridae																				
Mactra pura	ILF			P	P											V	S			
Deshayes sand																				
Austromactra rufescens	ILF			P				C			P			P		V	S			
(Lamarck) sand																				
Electromactra flindersi	ILF										P						S			
Cotton and Godfrey sand																				
Notospisula trigonella	ML								P					P			S			
(Lamarck) sandy mud																				
Anapella pinguis	ML			P	C			P	D			P		D	D	V	S			
(Crosse and Fischer) sand, sandy mud																				
Amphidesmatidae																				
Amphidesma angusta	ML			D			C	C								V	S	N		
(Reeve) sand																				
A. cuneata	ML							P								V	S	N		
(Lamarck) sand																				
A. erycinaea	ML							P			P					V				
(Lamarck) sand																				
A. nitida	ML					P								P		V				
(Deshayes) mud																				
Hiatellidae																				
Hiatella australis	ILF									P						V	S	N		
(Lamarck) rock																				
Crepipoda																				
Ischnochitonidae																				
Ischnochiton lineolatus	ILF			P			P				P					V	S			
(Blainville) rocks																				
I. elongatus	ILF		P	C			C			C						V	S			
(Blainville) rocks																				

	Place on Shore	West		North		East		South		Max. Shelt.					
		Exposed	Semi-exposed	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	West Arm	Pipe Clay Lagoon	East Coast Lagn.	Victoria	South Australia	New South Wales	South Queensland
Heterozona subviridis	ILF	P					P			P						V	S		
Iredale and May rocks																			
Ovatoplax mayi	ILF						P									V	S		
(Pilsbry) rocks																			
Ischnoradsia cyanida	ML						P			P									
(Sowerby) rocks																			
I. novaehollandiae	ML			C												V	S		
(Reeve)																			
Cryptoconchidae																			
Acanthochiton sueurii	ML		P			P							P			V	S		
(Blainville) rocks																			
Plaxiphoridae																			
Poneroplax albida	ML			P			P									V	S		
(Blainville) rocks																			
P. costata	ML	P						P	P							V	S		
(Blainville) rocks																			
Chitonidae																			
Amaurochiton glaucus	ML								C	C									
(Gray)																			
Syphurochiton maugeanus	ML	P		C	C	C	C	C	C	C			C				S		
Iredale and May rocks																			

In Table 2 the distribution of species is according to the writer's knowledge, and is not necessarily complete. In indicating the place on the shore occupied by the various species, the writer has been guided by the presence of the particular species in a living condition in most cases. In a few instances a mollusc may be very rare alive in the tidal area and its true habitat may be only below tide marks. This applies in the case of certain bivalves.

Zoogeography.

A map showing the extent of the zoogeographical regions in Australia has been provided by Iredale (1937). In Table 2 the regional names have not been used, but State names inserted for convenience. According to Iredale, the Peronian Region extends from Southern Queensland to the East Coast of Tasmania. The Flindersian Region extends from Western Australia to the West Coast of Tasmania and includes the North Coast. A Maugean Sub-region includes the East Coast of Tasmania.

The writer holds that the Peronian Region has its affinities with the deep water mollusca of the East Coast, and this seems in accord with Iredale's opinion. The North Coast shows affinities with the Flindersian region, in some places strongly, but in general the reason for this is as much ecological as geographical. The Tasmanian aspect is too strong to be submerged by inclusion of this area in the Flindersian region without considerable qualification. Bennett and Pope (1953) suggested that the Maugean Province should be extended to include all Tasmania and the Victorian exposed coast. The writer is in accord with this opinion. Hence Tasmania is here suggested as representative of the Maugean Region with direct affinities with Victoria, particularly the exposed Victorian coast. Affinities with the Peronian Region exist in the East Coast fauna, especially in forms living below low tide. Affinities with the Flindersian Region exist on the West Coast and North Coast, being most noticeable in the forms between tides on the North Coast.

The Bass Strait area has not been discussed to any extent in this paper, but it seems that the Maugean Region should include the Bass Strait Islands. There are very noticeable Peronian influences on Flinders Island, and Flindersian on King Island.

Dr. Guiler has several times made observations concerning the relationships of the Tasmanian rocky shores to those of the Mainland (1951 *b*, 1952 *c*, 1954, 1955), and to those of New Zealand and South Africa (1952 *c*).

With few exceptions, the sandy shore molluscs living in Tasmania which are not found also in Victoria are peculiarly Tasmanian species. The writer has used the South Australian name for a south Tasmanian shell, *i.e.*, *Electromactra flindersi* Cotton and Godfrey. The Victorian shell is the Peronian *E. antecedens* Iredale, which is very closely related. Our shell may actually be this species, but without comparative material the matter is uncertain. *Laternula tasmanica* (Reeve) is the Tasmanian representative of the mainland *Laternula recta* (Reeve). There is not a great deal of difference between this species and the north Tasmanian form.

Cotton (in Crocker and Cotton 1946) summarised the main sand beach and estuarine beach shells of South Australia, and these compare closely with those of Tasmanian beaches. *Glycymeris radians* listed by

Cotton is, however, rare in the Tasmanian or Maugean Region. Of the estaurine shells, *Anapella adelaidae* and *Laternula recta* are not present here. This applies equally to *Assiminea granum* Menke. South Australian beaches have been treated generally by Johnston and Mawson (1946) and by Cotton and Godfrey (1938) and Cotton (1954 *b*). The most important difference which emerges is the presence of the "Pipi" *Plebidonax deltoides* (Lamarck) on the exposed beaches. This mollusc is present in similar situations in the Peronian Region. In New Zealand the "Toheroa," *Amphidesma ventricosum* Gray, is equivalent in occurrence and habitat to the "Pipi." In Tasmania, however, there appears to be no similar occurrence, and certainly nothing of economic value as are the above species. It is easy to show that Tasmanian species are related to or identical with Mainland species. It is on the Mainland rather than in Tasmania that different species appear in number, and different ecological features are indicated. This has been shown amply in the rocky shore faunal studies, and it should be expected on the sandy beach. It is less easy to show from sandy beach molluscs alone that Tasmania should be regarded as a distinct Region. In checking against New South Wales beach shells as detailed by Allan (1946), greater differences are observable. Several Tasmanian species are present, but in other cases the Tasmanian species are replaced by other species, *e.g.*, *Placamen molimen*, *Notospisula producta*.

On the New South Wales tidal flat (Allan 1947 *a*) *Pyrazus ebininus* and *Anadara trapezia* are significant. The first species lived here in Tasmania, and sub-fossil specimens are found, but its place is now taken by *Velacumantus australis*, which lies about on the tidal flat in a similar manner. *Anadara trapezia* probably did not extend south of the Bass Strait Islands in the past, but it still exists in Victoria. There seems to be no equivalent species in Tasmania. The southern *Katelysia spp.*, *Macoma deltoidalis*, and *Anapella pinguis*, are replaced in New South Wales by *Paphia turgida*, *Proxichione matona*, *Circe sugillata*, etc., but it is of interest that *Flavomala biradiata*, *Laternula creccina* and *Ostrea angasi* are common to the two Regions.

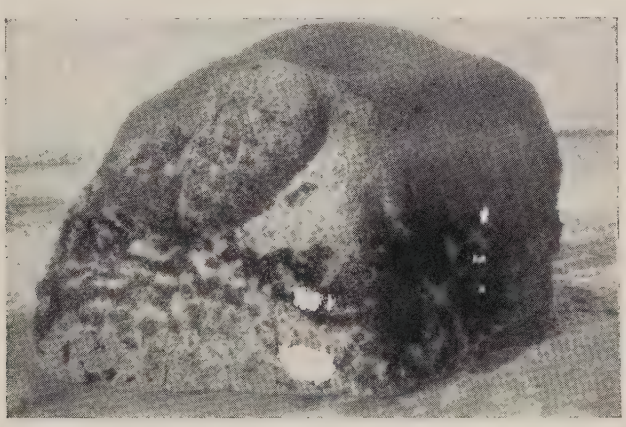
Summary.

The more detailed information now available on the Tasmanian intertidal molluscan fauna has made possible a new appraisal of its relationships. It is closely comparable with the faunas of the nearby mainland coasts, and less so with the faunas of Western Australia, New South Wales and southern Queensland. There is little resemblance to the tropical Australian fauna, but some affinity with New Zealand is recognised. Contrasts on the Australian coast may well be as much due to facies as to any other factor.

The mollusca of the east and south-east coasts of Tasmania show Peronian affinities, while those of the north and west show Flindersian affinities. Moreover, Bass Strait is a faunal "cross roads," so sharp boundaries for the zoogeographic regions are not desirable there. Nevertheless, the Tasmanian fauna has an individuality of its own, which tends to indicate that a separate region should be recognised here. Hence the writer agrees with Bennett and Pope (1953) that a Maugan Biogeographical Province may suitably include all Tasmania, and, in addition, the exposed coast of Victoria.

Acknowledgments.

The writer is indebted to Dr. Eric Guiler for permission to make use of his molluscan collections in this work. The writer is indebted to Miss Elizabeth Pope for the identification of barnacles collected during the tours on which this work is based. He is indebted to Mr. E. D. Gill for his continued interest and for notes on *Velacumantus australis*, which though not quoted in this work, have been another link in the chain.



Text figure 2:
Granite boulders at Bridport, north-east Tasmania, showing belt of *Modiolus pulex* Lamarck (Black).

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